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ENVIRONMENT AND ENERGY RESEARCH PRIORITIES

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ENVIRONMENT AND ENERGY RESEARCH PRIORITIES

1995

STANDARDS DEVELOPMENT BRANCH
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INTRODUCTION

ENVIRONMENTAL RESEARCH PROGRAM

The Environmental Research Program (ERP) of the Ministry of Environment and Energy (MOEE) is mandated to facilitate, through well-defined research projects, the solution of significant or urgent problems related to the environment and/or associated human health effects. The ERP will support environmental and energy research projects that will best serve the priority programs of the Ministry. Thus, it is expected that the Ministry will be in a better position to successfully implement its strategic programs by facilitating the solution of those problems which impede their delivery.

The Research and Technology Section (RTS) of the Fiscal Planning and Information Management Branch of the Ministry is responsible for managing the Environmental Research Program. It is the RTS' responsibility to maximize the benefits resulting from the environmental research and technology development funded by the MOEE.

DEFINITIONS OF RESEARCH

According to OECD*, research and development activities can be classified under three sub-headings: Basic Research, Applied Research, and Experimental Development.

Basic Research is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application or use in view.

Applied Research is also original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific practical aim or objective.

Experimental Development is systematic work, drawing on existing knowledge gained from research and practical experience, that is directed to producing new materials, products and devices, to installing new processes, systems and services, and to improving substantially those already produced or installed.

For the specific purpose of applying for research grants under the ERP, activities defined under the Basic and Applied Research may be considered for funding. For Experimental Development type of activities, applications may be made to the Ministry of Environment and Energy under the Environmental Technologies Program.

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*"The Measurement of Scientific and Technical Activities", OECD, 1981.

ENVIRONMENT AND ENERGY RESEARCH PRIORITIES - 1995

PRIORITY-SETTING PROCESS

The Research and Technology Section establishes the annual research priorities with the assistance of the Research Advisory Committee (RAC) and Ministry staff. In setting priorities, these parties consider the short and long term environment and energy research needs, the program's earlier achievements and research being conducted elsewhere.

The Research Advisory Committee (RAC) of the MOEE investigates various avenues to define its funding approach and ensures that funding for environmental research is directed at those areas most closely matching Ministry policies and programs. Ministry scientists and policy-makers identify specific research needs for the Ministry to deliver its programs. The proposed research objectives are then reviewed against the principles of pollution prevention, multi-media considerations and zero discharge. These are further screened in relation to the following criteria:

- Does it address MOEE policies and/or programs?
- What is the urgency of the problem?
- Is there potential for multi-program support?
- Does it have positive environmental impact?
- Are there significant socio-economic benefits?
- Is there potential for cost-sharing (50% or more) by forging partnerships with other researchers/agencies?
- Is the work inter-disciplinary in nature?
- Are there potential benefits to researchers or technology developers in Ontario?
- Are there potential cost-reductions to the Ministry by using the results of the proposed work?
- What is the timeframe for delivery of research results and does it satisfy Ministry's needs within that timeframe?

PRIORITIES

As a result of the intensive consultations within the Ministry, a number of research priorities have been selected and incorporated into this booklet. This document is the result of a targeted research management process whose purpose is to ensure that funded projects contribute in a measurable way to the achievement of MOEE goals and objectives.

The document has been categorized by research goals and objectives. The background information is provided for each research objectives and the expected tasks are listed thereunder. The expected application of the research has also been identified. Name(s) of the contact person(s) for each research objective have been identified. They should be contacted for any questions concerning tasks, budgets, collaborations and co-funding requirements.

Goals:

All of the research objectives described in this document are intended to advance a specific Ministry **goal** and enable proposals to be identified with a specific Ministry program or strategy. There are a total of 13 goals included here with one or more research objectives listed under each goal. Each **goal** is identified by a roman numeral. A summary of this year's goals is:

I. Ecosystem Health;
II. Human Health Effects;
III. Pesticides;
IV. Drinking Water;
V. Domestic Septic Systems;
VI. Detection, Transport and Fate of Pollutants;
VII. Waste Reduction, Reuse and Recycling;
VIII. Landfills;
IX. Potential Applications of Waste;
X. Technology Assessment;
XI. Environment and Energy Policy Development and Economics;
XII. Land Use Planning; and
XIII. Odour and Noise Pollution, and Vibration.

To assist researchers, key words have been identified for each research goal in the **key word index**.

Objectives:

Under each goal, one or more specific "**Objectives**" are listed. These are the specific questions to be addressed and are numbered as 1, 2, etc. Each objective is usually considered a separate project, however, there may be components of objectives that could be combined.

Background:

Background information is provided describing the need for this research objective and how it relates to the Ministry goal.

Tasks:

The **tasks** that are assigned to each research objective are only some recommended ways of achieving the stated objective. These are not intended to limit research proposals, but provide guidance to researchers. All the tasks listed under each research objective do not necessarily have to be carried out by the same research investigator/team. In other words, a proponent may wish to focus on one specific task or send a comprehensive proposal encompassing all the tasks.

Application:

The **application** refers to the intended use for the research.

Contact:

The **contact** is the individual who has been identified to respond to any questions regarding the research objective.

PARTNERSHIPS

The Environmental Research Program is actively promoting partnership arrangements between institutions, government agencies and the private sector. With the limited funds available and the diverse nature of environmental research, only those proposals will be given primary consideration which demonstrate evidence of co-funding from other partners for a minimum of 50% of the total proposed budget. Copies of applications made to other agencies/partners and their responses, if available, should be attached to the research proposals.

Partnership funding sources may include groups such as Federal and Provincial Government agencies, other Branches of the MOEE, industry associations and industry. Research teams could be made up of university faculty members, consultants, and research staff from the government and private sector companies. It is anticipated that this would enhance university-industry-government collaboration for research work of strategic importance to all parties.

POST-DOCTORAL FELLOWSHIPS

A number of Post-Doctoral Fellowships (PDFs) will continue to be offered in 1995-96 to the qualified candidates. The maximum term of such fellowships is two years and the remuneration is usually at the NSERC rates. The successful candidates will be required to work at the Ministry facilities, unless otherwise indicated. This will give a good opportunity for fellows to gain some practical experience working with the Ministry scientists.

Qualified candidates for PDFs are those who have already completed their Ph.D. in an appropriate discipline or are about to defend the thesis. If qualified post-doctoral fellows are not available for a position, those entering a Ph.D. program may be considered. More details will be provided at a later date through advertisements, which will be sent to the universities for placement on bulletin boards.

APPLICATION PROCEDURES

FULL PROPOSALS

You are urged to review this document carefully to identify if your proposal would fit under a specific goal or objective and the stated tasks thereunder. If you intend to submit a proposal for which goal/objective has not been stated in this document, please read under the **notices of intent** (NOI) in this section.

General application procedures and forms including information on eligibility criteria are included in the Application Kits which may be obtained from the **Grants Assistant** at (416) 323-4649. General questions on the Environmental Research Program can be addressed to the **Manager, Research and Technology Section** at (416) 323-4581. Specific questions on research objectives described in this document should be addressed to the technical contact person listed under each objective. He/she should be able to answer any questions regarding tasks, budget allocations, collaboration and partnership opportunities.

Deadline for Submission of Full Proposals:

Completed application forms along with the detailed proposals must be received by the ERP office on or before **January 16, 1995**.

NOTICES OF INTENT

*If your proposal does not meet a specific goal/objective and the stated tasks thereunder, a **notice of intent** form (copy available with the Application Kits) should be submitted for preliminary review of your idea by the Ministry staff.* These forms must be received by the ERP office on or before **December 2, 1994**. DO NOT SUBMIT FULL PROPOSALS UNTIL REQUESTED BY THE ERP STAFF. If a notice of intent is deemed appropriate to meet Ministry's immediate needs, the proponent will be informed of the decision within two to three weeks after the NOI submission deadline. If warranted, full proposals may be subsequently requested to be received by January 16, 1995. A small amount of money (up to 5% of available funds) may be directed towards proposals which result from the notices of intent.

BUDGETING

Proponents who wish to submit applications with several goals/objectives/tasks in mind must indicate a separate budget for each objective/task if done separately and how much money would be saved by combining those tasks or objectives.

REVIEW AND APPROVAL PROCESS

PROPOSAL REVIEW

After the proposals are received and pre-screened, a thorough technical review will be conducted. This process is completed within six to eight weeks of final submission deadline. The following criteria (not in order of importance) will be used for this purpose:

- support of MOEE policies or programs;
- environmental and socio-economic benefits;
- potential for cost-reduction in Ministry's operations;
- scientific and technical merit of the proposal;
- inter-disciplinary nature of the proposed work;
- competence of the researcher(s);
- likelihood of achieving objectives on time;
- potential for implementation of results;
- degree of collaboration with other researchers;
- evidence of partnerships (cost-sharing) with other institutions, governments and/or industry;
- potential for training highly qualified scientific personnel; and
- quality of the facilities.

The proposals which are successful in the review process undergo needs assessment from a technical review committee. These are assessed against budget availability and are either recommended or rejected.

APPROVAL PROCESS

The proposals which are recommended by the technical review committee are presented to the Research Advisory Committee (RAC). Proposals approved by the RAC are sent for final approval by the Senior Management of the Ministry. This process may take an additional four to six weeks after the reviews are completed. It is expected that the overall review and approval process will be completed on or before May 15, 1995.

Due to the limited budget, funds are not necessarily allocated for all the research objectives outlined in this document. Even if a proposal addresses one of the stated research objectives, there is no guarantee that it will be funded. Moreover, for some research objectives, no proposals may be deemed suitable for funding.

RESEARCH GOALS KEY WORD INDEX

GOALS	KEYWORDS
To improve the knowledge of water treatment for the delivery of safe, adequate quantities of *drinking water*.	CORROSION ANALYSIS, AQUIFER STORAGE AND RECOVERY
To protect groundwater and surface water from water being contaminated by *domestic septic systems*.	SEPTIC SYSTEMS, NUTRIENT LOADING, SUBSURFACE PHOSPHORUS MODELLING.
To improve methods and strategies for the *detection, transport and fate of pollutants* and their effect on the environment.	HYDRODYNAMIC DISPERSION, PROCESS PARAMETERIZATIONS, SAMPLING METHODOLOGIES, EMISSION MONITORING, AIRBORNE SVOCs, PAH MONITORING, SVOC PATHS AND FATES, RISK ASSESSMENT, AIRBORNE TOXICS, AIR TOXICS RELEASE PROFILE, OXIDANT MODELLING, OZONE PRODUCTION AND CONCENTRATION, REAL TIME MONITORING, VOC CONCENTRATION, OZONE FORMATION, GROUND LEVEL AIR POLLUTANTS, ATMOSPHERIC POLLUTANT RELEASES, PHYSICAL MODELS, STACK EMISSION CONTROLS, SUB-SURFACE CONTAMINANTS, TOXICITY, FAECAL COLIFORM BACTERIA IN GROUNDH^{2}O, TREATED SOIL TOXICITY, ACID MINE TAILINGS
To establish strategies, approaches and procedures in the assessment of the impairment to *ecosystem health*.	HIGHWAY RUNOFF, BIOLOGICAL TESTS OF ECOSYSTEM IMPAIRMENT, CROP AND FOREST YIELD LOSS, GROUND LEVEL OZONE, IN SITU CONTAMINANT MONITORING METHODOLOGIES, AQUATIC HEALTH INDEX, STREAM BIOMONITORING, INTEGRATED HAZARD ASSESSMENT PROTOCOL, BIOACCUMULATIVE SUBSTANCES, ECOSYSTEM HEALTH INDICATORS, PHARMACOKINETIC MODELS, DOSE/EFFECT RELATIONSHIPS.
To assess the possible *human health effects* arising from exposure to various contaminants.	SHORT TERM ELEVATION OF AIRBORNE TOXICS, HUMAN HEALTH, STOCHASTIC METHODS DEVELOPMENT, CHEMICAL EXPOSURE, HUMAN HEALTH MORBIDITY, ENVIRONMENTAL-ECONOMIC DAMAGE, IN VIVO MEASUREMENT, BIOAVAILABILITY, DESORPTION AND ABSORPTION, PAH's AND TRACE METALS, DOSE RESPONSE.
To reduce the use of chemical *pesticides*.	PESTICIDES, HUMAN HEALTH, INTEGRATED PEST MANAGEMENT, URBAN PEST, ALTERNATIVE STRATEGIES, PESTICIDE CONTAMINATION, PESTICIDE REDUCTION, ANALYTICAL/MONITORING TECHNIQUES, SAFE HANDLING.
To divert from disposal at least 50 percent, by the year 2000, through *waste reduction, reuse and recycling*, compared to 1987 as a base year.	3Rs BARRIERS, 3Rs PATHWAYS, COMPOSTING EMISSIONS, CHEMICAL AND BIOLOGICAL SPECIES, HEALTH IMPACTS, NON-TRADITIONAL FEEDSTOCK, MIXED RESIDENTIAL PAPER REUSE, SECONDARY MATERIALS PROCESSING, CHEMICAL DISCHARGE, SOIL APPLICATIONS.

GOALS	KEYWORDS
To protect the environment and human health from the impacts of *landfills*.	LANDFILL GAS RELEASE, METHANE MIGRATION, FIRE AND EXPLOSION THREAT.
To assess the *potential applications of waste*.	HAULED SEWAGE, GROUNDH^{2}O, DETOXIFICATION AND REUSE OF SOLIDS, NON-AGRICULTURAL LAND APPLICATION, COAGULANT RESIDUAL MOBILITY, SLUDGE DE-INKING.
To *assess technologies* in terms of cost effectiveness in support of environmental protection.	REMEDIATION, CSOs, STORMH^{2}O, ALTERNATIVE DISINFECTION TECHNIQUES, DRINKING H^{2}O, BIOREMEDIATION.
To support the corporate *policy development and management practices* of MOEE through research and development of advanced multi-disciplinary methods to integrate scientific, legal, social and economic information in policy decision-making.	RISK ASSESSMENT, ECONOMIC INSTRUMENTS, NON-REGULATORY APPROACH, CORPORATE POLICY, ENVIRONMENTAL PROTECTION PERFORMANCE, ENVIRONMENTAL SUSTAINABILITY, INDICATORS, REVERSE ONUS POLICY, TOXIC SUBSTANCE REGULATION, MULTI MEDIA APPROACH TO POLLUTION PREVENTION, FIRST NATIONS INITIATIVES, JURISDICTIONAL CLARITY, ENVIRONMENTAL MANAGEMENT, CONTAMINANT SPILLS, ENVIRONMENTAL DAMAGE, QUANTIFICATION METHODS, GREENHOUSE GAS EMISSIONS, CLIMATE CHANGE, NATIONAL ACTION PROGRAM, ENERGY IMPACTS, SCENARIO PROJECTION, FULL COST ACCOUNTING, RENEWABLE RESOURCES VERSUS CONVENTIONAL ENERGY RESOURCES, ELECTRIC VEHICLES, REGULATION AND LEGISLATION.
To support *land use planning*.	NIAGARA ESCARPMENT, CUMULATIVE EFFECTS MONITORING, H^{2}OSHED BASED DATA MANAGEMENT MODEL.
To examine opportunities to reduce *odour, and noise pollution, and vibration*.	ODOUR, ASPHALT CEMENT, FOUNDATION WALL EXTERNAL ISOLATION, RECTANGULAR VENTILATION LOUVRES, ACOUSTIC PROPAGATION.

GOAL I:

TO ESTABLISH STRATEGIES, APPROACHES AND PROCEDURES IN THE ASSESSMENT OF THE IMPAIRMENT TO *ECOSYSTEM HEALTH*

GOAL I

TO ESTABLISH STRATEGIES, APPROACHES AND PROCEDURES IN THE ASSESSMENT OF THE IMPAIRMENT TO *ECOSYSTEM HEALTH.*

OBJECTIVE 1

To apply biological tests in the assessment of ecosystem impairment associated with highway run-off.

Background: Assessments of ecosystem health are largely based on chemical guidelines, at times supported by in-situ surveys for impairment to species, biological populations or community structure. It is often more practical to use biological tests directly to predict as well as measure impairment. Integrated use of biological toxicity tests and indicators of impairment is a practical and cost effective approach. A relevant approach would also establish cause-effect relationships between environmental contaminants, lethal or sub-lethal toxicity and measures of impairment.

A practical application is the assessment of potential ecosystem impairment associated with highway run-off. Highway run-off, containing a variety of contaminants including hydrocarbons, metals, tire residue, vehicle fluids, lubricants, deicing materials and PaH's, are generally discharged directly into the aquatic environment. Recent studies have shown these discharges, at times, to be toxic to aquatic organisms. There is a need to assess the ecosystem impairment associated with highway run-off and to establish cause-effect relationships between contaminants and this impairment.

Tasks:

(a) Define critical indicators of ecosystem impairment in lake, river or marsh environments potentially affected by highway run-off.

(b) Establish predictive models linking deviations in these indicators with results of new or existing laboratory bioassays.

(c) Establish cause-effect relationships between indicators of ecosystem impairment and:

- lethal or sub-lethal toxicity;
- bioaccumulative contaminant tissue levels;
- biochemical indicators of exposure(e.g., mixed function oxidase, metallothionein);
- cellular genotoxic damage;
- habitat destruction or contaminant avoidance; and
- which may be measured by bioassays applied to highway run-off.

(d) Use biological assays and physical or chemical fractionation techniques to identify toxic contaminants in highway run-off which may cause ecosystem impairment.

Application: Resolution of issues relating highway run-off with potential ecosystem impairment. Identification of contaminants candidate for regulation, if ecosystem impairment is identified.

Analytical cost savings by reducing need for detailed chemical analysis to cases warranted by biological screens.

Ecosystem health or impairment assessment approaches utilizing biological tests to predict as well as measure impairment or absence of same.

Contact: Dr. D.A. Rokosh (416-235-5967)

OBJECTIVE 2

To develop more comprehensive and accurate assessments of yield losses in both crop and forest plant species resulting from high ground level concentrations of ozone in Ontario.

Background:	Ozone now represents the greatest environmental threat to vegetation in Ontario because of its phytotoxicity and its widespread presence. Its effects are not necessarily obvious because reduced plant growth and productivity may not be accompanied by foliar expressions of toxicity (i.e., lesions) and because of the general ubiquity of exposure. The effects of ozone in forest production in Ontario has had very little attention. Slightly better information is available for cultivated crops, but estimates of crop yield losses have been based primarily of research conducted outside Ontario. Better measures of ozone impacts and associated threshold levels in ambient air are needed for both crop plants and forest species.
Task:	Set up additional research sites and test species in Ontario as part of the planned EcoResearch Program on terrestrial impacts, sponsored under Environment Canada's Green Plan.
Application:	To provide relevant dose-response information for establishing standards and making sound management decisions on necessary hydrocarbons and nitrogen oxide control programs which might have far-reaching economic ramifications.
Contact:	Mr. R.G. Pearson (416 323-5102)

OBJECTIVE 3

To develop new methodologies (preferably non-destructive) for monitoring contaminants in plants and wildlife, under field conditions, without or with minimal use of expensive chemical analysis techniques.

Background: The Ministry of Environment and Energy is charged with the responsibility of protecting humans and natural ecosystems from contamination, whether from industrial, commercial or institutional sources. As a consequence MOEE staff either collect or have collected on their behalf, a large number of samples of plant tissue, wildlife tissue, soils and sediments. The costs of analyzing these samples continues to rise, particularly for newly discovered "exotic" organic compounds.

Tasks:

(a) To define critical indicators of impaired ecosystem health (in aquatic, terrestrial and atmospheric environments) and to establish predictive models linking these indicators with the results of new or existing biological assays.

(b) To establish cause-effect relationships between:

- specific contaminants and lethal or sub-lethal biological endpoints with emphasis on evaluating the utility of biomarkers or biochemical indicators;
- biological tissue contaminant levels and effects on organism health; and
- lethal or sublethal end-points as measured in laboratory bioassays and whole organism or population effects in the environment.

(c) To develop new non-destructive (in situ measurements) methods for assessing contaminant levels in the field without resorting to chemical analyses.

(d) To test method(s) under field conditions and transfer the same for Ministry use.

As an example the MOEE is currently funding work on *Vallisneria*, an aquatic macrophyte (water plant) which appears to respond to exposure to contaminated sediments, through reduced root mass relative to shoot mass.

Application: New methods could be put to work immediately by Ministry staff; with potential resource savings in laboratory analyses.

Contact: Mr. Doug Harper (416-235-6046)

OBJECTIVE 4

To pursue the development of multi-component (holistic) index of the health of the aquatic environment by attempting to derive an empirical formulation of a suite of accepted indicators and measures of key features of environmental condition which when calibrated for a geographical area and range of conditions can subsequently be used to characterize and report on environmental conditions for that area.

Background:

The Ministry collects a diverse range of environmental information in its Great Lakes monitoring and surveillance projects. Data are routinely collected on water and sediment quality, concentrations of contaminants in biota, composition of selected biological communities and various physical features of the environment. The evaluation of information varies with the purpose of the study and the type of data collected. Measurements may be related to: (a) fixed objectives, guidelines and standards, (b) compared with background or past measurements, (c) used to provide data with which to compute values for empirical and quantitative indices for assessment purposes, or (d) merely to describe conditions. A major difficulty in the collective evaluation of the environmental data is that it is difficult to integrate the diverse information into a unified statement of conditions which are clearly expressed and concise. There are both practical and theoretical difficulties associated with the development of such a statement. However, this does not preclude the possibility that a descriptive/empirical approach can be developed to bring together, in a concise and clear manner, key elements of the diverse information that is collected where the interpretation of the individual elements is reasonably well understood. Because of the lack of conceptual basis for defining a single measure of "ecosystem health", any composite index must incorporate elements that can be easily separated, and whose inter-relationship can be readily examined and tested. The objective of this approach is to describe environmental features in a simplified and interpretable manner. This should no be viewed as an attempt to provide a model of the environment.

Tasks:

(a) Review the field of integrated (composite) indicators with particular attention to past application of integrated biological indicators. Identify candidate approaches to formulating the index as well as identify the conceptual/ logistical constraints with the approaches.

(b) Assess the type of information collected routinely in Great Lakes monitoring programs and identify the features of the information which are amenable to description by accepted indices/criteria/objectives/guidelines. Focus on data collected in Ministry programs but also include other types of information use by other jurisdictions in the Great Lakes. Identify a set of component measures with which to build a composite index. Accumulate a database from existing results with which to use in the mathematical development and calibration of the index.

(c) Collect independent data with which to field test the predictions of the composite index and to evaluate its performance.

Application: The expectation is that an integrated index of environmental condition, calibrated to regions of the Great Lakes, can be developed which could be used in the routine reporting of the environmental quality of the aquatic environment.

Contact: Mr. Todd Howell (416-235-6225)

OBJECTIVE 5

To design, develop and conduct cost-effective studies and strategies to biomonitor stream in: (a) old growth forests (to obtain baseline information on community structure of aquatic invertebrates) and (b) tributaries to Lake Simcoe (to determine stresses resulting from agriculture, construction and habitat modification by to cattle farming and channelization).

Background:

Surveys of macroinvertebrates communities in streams are presently being conducted in different locations in Ontario. Many of these locations have been changed by man-engendered influences (e.g., acidification, siltation, nutrient enrichment, agriculture, forestry practices, housing and road construction).

Documentation of changes in aquatic invertebrate populations has been central to the demonstration of the deleterious impacts of impaired water quality. First, the vast majority of animal species inhabiting streams and lakes are invertebrates. Second many of these species have physiologies, life histories, behaviour and habitat preferences that make them particularly sensitive to changes in water quality. Lastly, many sensitive species are widely distributed and occupy important positions in aquatic food webs leading to food sources important to sports fish and ultimately humans. Thus, the demise of these invertebrates represents a deterioration of overall aquatic ecosystem health.

Information is severely lacking on communities of indicator species of aquatic invertebrates in streams that have not been previously altered. There is also a need to establish relationships between changes to these communities and physical, chemical and biological stresses in aquatic environments.

Tasks:

(a) To determine, model and predict the normal range of spacial and temporal variation in relative abundance and diversity for potential indicator species of macroinvertibrates at 30 to 40 undisturbed stream locations (e.g., Temagami and Spanish old growth forests in Northern Ontario).

(b) To determine, model and predict the range of spacial and temporal variation in relative abundance and diversity of macroinvertibrates species at 30 to 40 streams in the Lake Simcoe drainage network.

(c) To model and predict changes in macroinvertibrate communities associated with stresses due to physical, chemical or biological disturbances in streams in the Lake Simcoe drainage network.

(d) To provide a comprehensive database documenting variation in water quality and associated changes in macroinvertibrate communities in streams in south-central Ontario.

Application: This information can provide essential baseline information for a Environmental Protection Model as well as for implementing current Provincial Water Quality Objectives. These studies will supply impact/non-impact information required by legislation for regulation, enforcement, protection and management of water resources in Ontario.

Contact: Mr. Ron Hall (705-766-2418)

OBJECTIVE 6

To develop an integrated hazard assessment protocol that interrelates environmental media (air, drinking water, surface water, sediment, vegetation and aquatic life/wildlife) to ensure that standards set for any one medium will not result in degradation of another medium.

Background:

MOEE promotes a multimedia approach for the protection of the environment. At present, environmental quality objectives are developed on a media-specific basis but with linkages to other media (e.g., the Provincial Sediment Quality Guidelines "no effect" level for organic contaminants is derived from the Provincial Water Quality Objective using a partition coefficient). A more rigorous and standardized protocol is required to evaluate potential for transfer among all environmental compartments.

Tasks:

(a) Evaluate and document existing or readily-obtainable information pertinent to a determination of potential transfer of contaminants among environmental compartments - air, drinking water, surface water, sediment, vegetation and aquatic life/wildlife.

(b) Use the above information to develop a model that can be used to establish safe concentrations in each medium as well as estimating transfer of contaminants among media. Test the model using one or more persistent toxic bioaccumulative substances.

(c) Make recommendations on which compartments are most useful for standards derivation and compliance.

(d) Identify any limitations of the procedure in developing standards.

(e) Develop a manual or workbook on the protocol that could readily be used by staff.

Application:	Development of such a protocol would enhance the multimedia aspects of environmental standards and ensure protection of the most sensitive use, thereby providing the greatest benefit to ecosystem health.
Contact:	Dr. D.J. Spry (416 235-5054)

OBJECTIVE 7

To establish critical, tissue-specific, body burdens of persistent bioaccumulative substances to permit the development of scientifically-defensible standards for the protection of aquatic biota and wildlife.

Background: Environmental standards have tended to focus on environmental media such as water or sediments. For extremely hydrophobic chemicals, water quality criteria may be inappropriate since the chemicals of concern occur at very low concentrations, are difficult to measure, and from a regulatory perspective, difficult to interpret. Tissue residues for these substances are less variable, easier to measure and toxicologically easier to interpret since these chemicals act within the body with either specific or non-specific (narcotic) modes of action. Data relating tissue residues to effects in individuals, or more importantly, populations, are currently rare. Development of tissue residue concentrations related to toxicological endpoints such as growth and reproduction would permit the derivation of scientifically defensible environmental quality criteria which could be used in effluent regulation, state of the environment reporting and standards development.

Tasks:

(a) Using three persistent bioaccumulative chemicals, perform a thorough literature search to identify where such tissue residue data already exist. Identify any data gaps essential to criteria development.

(b) Perform laboratory exposures, using a suitable route of exposure (e.g., injection, infusion, dietary exposure) and accepted laboratory procedures for the study of bioaccumulation, relate steady-state residues to toxic effects.

Application: Protection of ecological health impairment from persistent bioaccumulative substances needs to be assessed by standards which are developed for appropriate media. Water quality monitoring for these substances is not appropriate in most cases. Standards development needs to rely more on compartments where these chemicals are readily measured or their effects occur, such as tissue residues.

Contact: Dr. D.J. Spry (416-235-5054)

OBJECTIVE 8

To determine Ecosystem Health Indicators and Costs of Interventions.

Background:

Ecosystem Health refers to the degree or extent to which a defined ecosystem is degraded or damaged as compared to a reference or initial state of the environment. The pre-industrial, pristine condition of a lake or a river or a plot of land may be the appropriate reference state. Analysts may define another reference state which includes human occupation and transformations and alterations.

Ecosystem deterioration often presages adverse effects on human populations and is the primary reason for efforts to measure Ecosystem Health.

There are many different measures of Ecosystem Health proposed by researchers and theorists. Students of this issue have not agreed on the most important measures so that systematic data gathering and monitoring can begin.

There is also little information on the value that people ascribe to ecosystem health measures. One approach to assess the value of ecosystem health is to observe how much individuals and governments spend to try to protect or restore ecosystems. A study was recently released in which 500 life-saving actions or interventions were identified, the costs of these interventions were estimated and transformed to comparable values and the cost-effectiveness of each intervention was computed and compared (Tengs, T.O. **et al.**, July 1994, "Five-Hundred Life-Saving Interventions and Their Cost-Effectiveness", Centre for Risk Analysis, Harvard School of Public Health).

This method could provide useful insights concerning the value of ecosystem health as well as the cost-effectiveness of actions to preserve or restore these features.

Tasks:

(1) Define operational indicators of ecosystem health.

(2) Define interventions to protect ecosystem health and differentiate them from activities/interventions that are intended to achieve other objectives.

(3) Critically survey the literature and other sources for data concerning government and private sector expenditures on interventions to protect or restore ecosystem health.

Application: Provides information with which to identify indicators of ecosystem health and costs of interventions in order to assess their relative importance or worth in policy and program development and evaluation. To be reviewed with the Environmental Monitoring and Reporting Branch for potential partner.

Contact: Dr. Jack Donnan (416-323-4611)

OBJECTIVE 9

Develop food chain and/or pharmacokinetic models to determine dose/effect relationships between aquatic organisms and contaminants in their ecosystems.

Background:

Contaminants can be discharged into surface waters from municipal and industrial point sources, and non-point sources, such as atmospheric deposition and basin runoff. Some of these contaminants may be accumulated into the aquatic foodweb at rates which depend on various environmental and physiological factors. Excessive contaminant accumulations have in the past adversely effected some aquatic organisms. Most criteria established for protection of aquatic biota are based on generic data referenced to the whole body wet weight rather than concentrations in specific affected organs or body systems. These criteria often include a large safety factor because of the uncertainty of the effect of a contaminant exposure level upon the aquatic organism. Models which consider the internal dosage to body organs and systems would allow more certainty in assessing the effects of contaminant exposure. This would lead to more efficient environmental remediation and control.

Tasks:

(a) Develop physiologically based pharmacokinetic (PBPK) models to establish a mathematically rationalized approach for the dose/effect relationships between aquatic organisms and contaminants in their ecosystems.

(b) Investigate the food web structures in the Great Lakes.

(c) Research on the bioavailability of heavy metals in various chemical forms.

Application:

Models linking contaminant exposures to the uptake by aquatic species and the internal dosage to body organs and systems would reduce the need for very large safety factors in the environmental criteria. This would result in more certainty in assessing the effects of water and sediment contamination and thus lead to more efficient environmental remediation and control.

Contact:

Mr. R. Boone (416-323-5181)

GOAL II:

TO ASSESS THE POSSIBLE *HUMAN HEALTH EFFECTS* ARISING FROM EXPOSURE TO VARIOUS CONTAMINANTS

GOAL II

TO ASSESS THE POSSIBLE *HUMAN HEALTH EFFECTS* ARISING FROM EXPOSURE TO VARIOUS CONTAMINANTS.

OBJECTIVE 1

To design strategies and conduct studies for finding correlations between human health effects and elevated short-term levels of airborne toxics.

Background: Until recently the human health effects of exposure to airborne toxic compounds have been approached from the perspective that only long term exposures were of serious consequence. Recent evidence suggests that even short term exposure durations of a few minutes or less may be important for some toxic contaminants. Very little data is available in Ontario on airborne concentrations for sampling periods less than 30 minutes. Most results are for 24 hour periods.

Tasks:

(a) Assess short term temporal variations (1-, 5-, 15-, 30–minute averages, within an 8-hour or 24-hour period) of airborne VOCs usually found in the urban environment.

(b) Determine spatial and temporal characteristics of acid aerosol levels in Ontario, and determine attribution to local and distant sources.

(c) Determine the correlation of acid aerosol levels with human health effects, with consideration of ground level ozone and inhalable particulate as confounding factors.

(d) Determine the particle size distributions for various trace metals in air, as found near the suspected sources and at receptor sites further downwind.

(e) Design strategies and conduct studies that will assist in determining links between human health effects and short term exposure to airborne toxics.

Application: Adds accuracy and confidence to risk assessment situations, with potential impact on setting of MOEE standards and guidelines. Helps environment and public health authorities to educate public and reduce human health effects due to air pollution.

Contact:
Mr. R. Bell (416-323-5171)
Dr. R. Chapman (416-323-5143)

OBJECTIVE 2

To conduct a scientific technical review of the use of stochastic methods of data analysis (such as Monte Carlo) in examining and assessing exposure as it is applicable to chemical health risk assessment.

Background:	An integral component of multimedia standards development and site-specific health risk assessments is the analysis of exposure to a given chemical. The Ministry assesses exposure using available environmental and biological monitoring data and may undertake additional studies to obtain further information. Stochastic modelling methods have been proposed as a method of quantitatively estimating the probability distributions for exposure to a given population and ultimately this information is used to assess health risks associated with exposure. The application of this method of data analysis to risk assessment is recent and requires further examination.
Tasks:	Critically evaluate stochastic modelling methods used in quantitating exposure when conducting human health risk assessments. This review should identify advantages and disadvantages relative to current approaches and make recommendations on how stochastic approaches should be used.
Application:	Human health risk assessments forming scientific basis for the development of multimedia health-based standards.
Contact:	Mr. Franca Ursitti (416-323-5076) Dr. Lee Hofmann (416-323-5118)

OBJECTIVE 3

To identify and evaluate quantifiers of human health morbidity (illness) effects and estimates of their value for use in environmental-economic damage and benefit assessments.

Background:

Human health effects of contaminants in air, water and soil are of key concern to the public, to the Ministry and to elected officials. Human health effects include measures of mortality (deaths) and morbidity (illness). Environmental protection activities and programs may not always avoid, reduce or eliminate human health effects, but where such effects might be present, it would help in developing informed policy to develop quantitative estimates of changes in mortality or morbidity measures associated with a problem or a proposed program.

Measures of mortality (deaths per group per time period) are well established and unambiguous. However, there are many measures of morbidity which are recorded by medical researchers (incidence of diseases, lung function disorders, birth weight, tissue morphological changes, etc.). Other measures of morbidity are more indicative of economic effects of illness on people: doctor visits, hospital visits, number of days off work, etc.

Different studies specify and apply different measures of morbidity. Guidance is needed as to which measures of morbidity would be most useful for data collection and environmental benefit-cost assessments in Ontario.

Tasks:

- Perform a critical review of a comprehensive set of human health effects studies.
- Define criteria with which to judge the usefulness and desirability of morbidity quantifiers for use in economic studies.
- Define criteria with which to evaluate monetary value estimates of quantifiers.
- Extract from comprehensive list of studies morbidity quantifiers and values, recalculate where necessary to make comparable and evaluate them with respect to criteria.

Application:

- Will provide guidance for deciding which quantifiers and associated values to use in MOEE policy and program development evaluations and for standard-setting assessments. To be reviewed with other MOEE branches as potential partners.

Contact: Dr. Jack Donnan (416-323-4611)

OBJECTIVE 4

To determine the bioavailability of particulate-bound environmental contaminants when exposure occurs through the dermal, oral and/or respiratory routes.

Background:

Potential health effect models depend not only on toxicological data but on estimates of exposure to the chemical/chemicals in question. Human exposure to most chemical occurs either through inhalation, ingestion, dermal contact or, more commonly, some combination of all three routes. Estimating the total dose, which is delivered, is essential if the health effects are properly evaluated. Knowledge of the levels of a compound in the various environmental media (water, soil, sediment, air, food etc.) and the contribution that each makes to the total intake provides only a partial picture of actual exposure. It is also necessary to have an understanding of the bioavailability of the compound from each of these media. This is of particular concern for compounds which are generally found in the environment bound to particulate matter. A knowledge of the amount of the compound which is likely to be removed from the particulate and taken up by the body is necessary to reduce the uncertainty surrounding estimation of dose.

Tasks:

Use or modify current *in vivo* methods to measure the bioavailability, desorption from particles and absorption kinetics of:

- trace metals such as chromium or mercury, on soil, sediment and other particulates when exposure occurs through the dermal, oral and/or respiratory routes;
- chlorinated dioxins on soil, sediment and other particulates when exposure occurs through the dermal, oral and/or respiratory routes (priority: respiratory > dermal > oral);
- polycyclic aromatic hydrocarbons, in particular B[a]P on soil, sediments or dusts when exposure occurs through the dermal, oral and/or respiratory routes (priority dermal > oral > respiratory);
- measure the adherence of soils/sediments to the skin during and after bathing or swimming or during terrestrial exposure to soils, sediments or dusts; or

- measure the amount of particulate swallowed during swimming or bathing.

In vitro methods can be considered for studies investigating factors affecting bioavailability after the *in vitro* methods have been validated with *in vivo* methods.

These studies must also take into account the physical and chemical properties of the chemicals and of the matrix in which the chemicals occur. The physiological characteristics of the absorption pathway (gastrointestinal tract, pulmonary system and skin) must also be considered.

Application: Improved estimates of exposure which will be used in establishing environmental guidelines and standards.

Contact: Dr. A. Li-Muller (416-323-5114)

OBJECTIVE 5

To determine the effects that route of exposure have on the potency and site of action of selected compounds including polycyclic aromatic hydrocarbons and trace metals.

Background: Human exposure to most chemicals occurs through some combination of inhalation, ingestion or dermal contact. In many instances, the route by which a chemical enters the body will affect its potency and possibly its site of action. Despite the importance of the route of administration on estimating potential health effects, there is little experimental data which can be used in the risk assessment process. As a result, risk assessments do not account for these factors when assessing risk or rely on numerous assumptions many of which are untested. Both approaches introduce uncertainty into the final risk estimate.

Tasks: Establish good *in vivo* dose-response curves following exposure to selected chemicals such as Benzo[a]pyrene when these compounds are administered via dermal, oral or respiratory routes. Preference should be given to developing dose-response curves for tumour incidence/multiplicity at different tissue sites.

Application: Improve the dose-response assessment component of the standard setting process by reducing some of the uncertainty which surrounds route to route extrapolations.

Contact: Dr. P. Muller (416-32-5109)

GOAL III:

TO REDUCE THE USE OF CHEMICAL *PESTICIDES*

GOAL III

TO REDUCE THE USE OF CHEMICAL *PESTICIDES*.

OBJECTIVE 1

To assess the environmental health impacts of pesticides used in outdoor and indoor urban environments.

Background:

The use of pesticides and their potential to cause adverse environmental health impacts continues to be an important environmental issue in Ontario. The mandate of the Ministry of Environment and Energy (MOEE) is to protect and enhance the quality of the environment for the present and future well-being of the people of Ontario. MOEE has the responsibility of administering the *Pesticides Act* and Regulation 914 and to provide direction on the responsible use of pesticides in Ontario. MOEE encourages and promotes the reduced reliance on and judicious use of pesticides through the implementation of integrated pest management (IPM) methods and alternative strategies to the use of chemical pesticides in urban areas.

Tasks:

(a) Develop sampling and collection methods to determine pesticide residues resulting from pesticide applications in outdoor and indoor urban environments.

(b) Develop analytical techniques to measure pesticide residues in air, water, soil or on indoor surfaces in areas that have been treated with pesticides.

(c) Assess the environmental health effects of pesticides applied in outdoor and indoor urban environments.

Application:

Sampling and analytical techniques to measure pesticide residues in urban indoor and outdoor environments.

Assessment of environmental health risk due to pesticide residues in urban environments.

Relevant information for establishing standards and making sound management decisions on urban pesticide control programs.

Contact: Mr. Geoff Cutten (323-5117)

OBJECTIVE 2

To develop and promote integrated pest management (IPM) programs and alternative strategies to replace or reduce the use of chemical pesticides with emphasis on urban pest problems.

Background: There is growing concern about the present reliance on synthetic chemicals for pest control, especially in urban environments (e.g., around homes, school yards, parks and golf courses). Research is necessary to look at all aspects of pest control with a view to reducing pesticide use. This can be accomplished by developing biological and other non-chemical pest control techniques to replace present practices.

Tasks:

(a) Review available scientific literature and identify where IPM methods or alternative strategies for managing urban pest problems are needed.

(b) Develop new IPM methods and alternative strategies to the use of chemical pesticides where methods and strategies are lacking.

(c) Develop action thresholds and methods to monitor pest populations.

(d) Evaluate biological chemicals as replacements for environmentally harmful chemicals in the control of disease, insect, weed and rodent pests.

(e) Investigate biological control organisms that could be used to successfully replace chemical techniques.

(f) Develop cultural alternatives to environmentally harmful chemicals for pest control.

(g) Develop integrated pest management protocols for buildings and structures.

Application: Public information material (i.e., brochures, industry newsletters, etc.), in a variety of media for use in education of the public and industry, promoting ecosystem protection and responsible pesticide use.

Contact: Ms. Violet van Wassenaer (416-323-5119)
Mr. Douglas Mewett (416-314-9235)

OBJECTIVE 3

To eliminate or significantly reduce the use of pesticides that cause damage to the environment through contamination of air, water and soil and/or impact on humans and other non-target species.

Background: The 1994 Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem (COA) commits the Federal and Provincial Governments to a goal of virtually eliminating persistent, bioaccumulative toxic substances from the Great Lakes Basin ecosystem. Under the COA, pesticides used or present in the basin shall be monitored and evaluated to determine if actions are necessary to reduce or prevent unintended adverse impacts on ecosystem or human health.

Tasks:

(a) Identification

Identify persistent or bioaccumulative toxic pesticides (and their breakdown/transformation products) that have the significant potential to cause adverse impacts on environmental health.

(b) Development of Analytical/Monitoring Techniques

Develop methods for determining levels of persistent or bioaccumulative toxic pesticides and their breakdown/ transformation products in air, water, soil, sediment and biota.

(c) Monitoring and Assessment

Prepare balance sheets on the environmental fate and impact of soil, vegetation and fumigant applied pesticides, partitioning into the soil, water, air and biological compartments.

Assess environmental residues to determine if levels are causing adverse impacts on environmental or human health, or if such impacts are likely to occur in the future if current emissions are not reduced or eliminated

Application: Information on quality of ecosystem health in the Great Lakes basin as influenced by loadings of pesticides and their breakdown/transformation products.

Contact: Mr. Adam Socha (416-323-5104)
Mr. Doug Mewett (416-314-9235)

OBJECTIVE 4

To promote the safe handling of pesticides in order to reduce or eliminate contamination of the environment.

Background: In keeping with the Ministry thrust to reduce, reuse, recycle and remediate as well as to prevent pollution.

Tasks:

(a) Develop closed systems for handling pesticides to prevent or reduce human exposure or losses to the environment.

(b) Determine the persistence and bioavailability of pesticides in recycled plastics.

Application: Protect the environment and the applicator and enhance product stewardship within the pesticide industry.

Contact:

Mr. Douglas Mewett (416-314-9235)
Ms. Lorna Poff (416-323-5116)

GOAL IV:

TO IMPROVE THE KNOWLEDGE OF WATER TREATMENT SYSTEMS FOR THE DELIVERY OF SAFE, ADEQUATE QUANTITIES OF *DRINKING WATER*

GOAL IV

TO IMPROVE THE KNOWLEDGE OF WATER TREATMENT SYSTEMS FOR THE DELIVERY OF SAFE, ADEQUATE QUANTITIES OF *DRINKING WATER.*

OBJECTIVE 1

To develop Ontario-based expertise for accurately and scientifically valid measurement of corrosion rates in drinking water distribution systems. To apply this knowledge to modify drinking water treatment so as to minimize effects including the appearance of rust in water, corrosion damage rates and associated maintenance and replacement costs and to reduce toxic corrosion product levels.

Background: Recent publications in the field of drinking water corrosiveness measurement have indicated that hydraulic factor control and statistical noise reduction techniques are needed for accurate coupon testing. The ability to develop and offer such measurements is an essential element in the control of lead and copper corrosion control. The use of new electrochemical techniques adapted to the high resistivity of drinking water and the interference of microbiological effects is required for treatment process optimization. The presence of iron and manganese at low levels in well water can prevent use of the water for direct use municipal supply unless the water is treated by sequestering agents to hold these staining impurities in suspension. The transport of water samples from distant sources and the lab investigation of optimal treatment is not presently possible and requires development.

Tasks: All the following to be proposed based on thorough review of the latest drinking water/corrosion literature and to take into account the context of current US EPA activity in this developing area of technology.

(a) Develop capability and validate coupon/DW corrosion measurement service/techniques at institutions interested in later continued commercial operation of fee-for-service corrosion measurement.

(b) Develop electrochemical laboratory skills to establish a validated technique for discriminating between probable candidate full scale treatment improvements which may minimize corrosion rates.

(c) Develop scientifically proven, controlled field validated methods/protocol for proposed treatment variations designed to minimize corrosion rates.

(d) Devise optimized iron/manganese sample transport and sequestering methods.

Application: Protection of all municipal water supply systems in Ontario from the costs of repair of corrosion damage. Delay or indefinitely postpone the installation of full water treatment plants to treat slightly metal contaminated well-water.

Contact: Mr. Dale Henry (416-235-6303)

OBJECTIVE 2

To better understand water quality changes that occur during aquifer storage and recovery (ASR).

Background:

ASR is becoming a more common method of meeting demand. During periods of water availability treated water is stored and during periods of high demand, water is recovered. ASR is often an efficient means to increase product water capacity and meet increasing water demand without expanding treatment capacity.

ASR technology has focused on hydrogeological elements associated with the flexrates of water into and out of aquifers. Relatively little attention has been directed towards **water quality** issues. The water to be stored is often quite different than native groundwater and when it is stored new equilibrium conditions are established between the water and the geological formations. Often water quality is monitored after a moderate amount of storage but long-term equilibrium shifts have not been observed.

There is a need to develop mechanisms to characterize the long-term interactions that occur during aquifer storage. Therefore, it is not prudent to base long-term performance (20 years or more) on short-term testing. Given the uncertainty surrounding this issue it is not now possible to even recommend a satisfactory test period.

Task:

- Review cases of water quality change in aquifer-stored water and the known equilibrium constants describing observed changes.
- The case studies should evaluate the geochemistry metal of the significant formations and of the native water quality. The species considered in the analysis of equilibrium conditions should include (but not necessarily limited to) iron, manganese, lead, zinc, pH, alkalinity, and phosphates.
- The equilibrium conditions should then be compared to the relationships observed between the compounds present in the formation and both the native groundwater and the water introduced to the aquifer.

Application: Provides knowledge of expected groundwater water quality following aquifer storage.

Contact: Dr. Ken Roberts (416-235-6250)

GOAL V:

TO PROTECT GROUNDWATER AND SURFACE WATER FROM BEING CONTAMINATED BY DOMESTIC *SEPTIC SYSTEMS*

GOAL V

TO PROTECT GROUNDWATER AND SURFACE WATER FROM BEING CONTAMINATED BY DOMESTIC *SEPTIC SYSTEMS.*

OBJECTIVE 1

To establish criteria to determine which environments allow for sufficient natural attenuation of domestic septic systems, and to develop passive, in situ treatment systems for those environments that do not possess sufficient natural attenuation.

Background: Groundwater in Ontario has already been contaminated as a result of inappropriate practices resulting in higher costs for alternative potable water supplies. Where groundwater is available, the typical high quality and low cost make it the water source of choice. The impracticality of cleaning up a groundwater resource to drinking water standards once it has been contaminated, underscores the vital importance of protecting our remaining groundwater resources before they can be contaminated by inappropriate practices.

Tasks:

(a) To develop a better understanding of why certain environment allow natural attenuation of domestic septic system effluent.

(b) To develop passive in situ treatment processes for those environments that do not have sufficient natural attenuation.

Application: In support of the Drinking Water Program.

Contact: Mr. Maurice Goodwin (416-323-5216)

OBJECTIVE 2

Develop improved domestic septic systems to remove nutrient loading as stress to recreational lakes.

Background:

The original Dillon Rigler (1974) model and the Ontario Lakeshore Capacity Study Trophic Status Model (1986) have gained widespread use for predicting the impact of shoreline residential development on lake trophic status by quantifying response of a lake to loadings of phosphorus from domestic septic systems. In practice, their use results in a capacity of a lake for development, which managers can express as either residential units or loading of phosphorus.

Such development restrictions were intended as interim measures that were to be applied until such time as phosphorus abatement technologies are approved. Recent research on abatement technology shows promise and pressure to develop capacity lakes will increase with an improved economy. Development and approval of an effective abatement technology would maintain water quality in the face of economic development of recreational lakes.

Tasks:

(a) Assess the effectiveness of existing abatement technologies with clear criteria identified.

Application:

A successful technology would be classified as a phosphorus abatement domestic septic system by MOEE. We would encourage its mandatory installation on all new residential construction on inland lakes and mandatory retrofit where old systems were replaced.

Contact:

Mr. Neil Hutchinson (705-766-2418)

GOAL VI:

IMPROVED METHODS AND STRATEGIES FOR THE *DETECTION, TRANSPORT AND FATE OF POLLUTANTS* AND THEIR EFFECT ON THE ENVIRONMENT

GOAL VI

IMPROVED METHODS AND STRATEGIES FOR THE *DETECTION, TRANSPORT AND FATE OF POLLUTANTS* AND THEIR EFFECT ON THE ENVIRONMENT.

OBJECTIVE 1

Develop appropriate hydrodynamic dispersion models for 3-dimensional flows in lakes and 2–dimensional flows in rivers.

Background: Contamination of water bodies and sediments can impact both the aquatic environment and various water uses of residents of Ontario; drinking water, recreation and sport/commercial fishing. To assess the contaminant levels in the water column after an accidental release (spill) or an event type of discharge, hydrodynamic/ dispersion models are needed. These models must track discharges of contaminants for long time periods over long distances where the detailed circulations near the shoreline and the complications of vertically stratified lake conditions must be considered.

Tasks:

(a) Develop appropriate hydrodynamic dispersion models which can track dynamic contaminant discharges for long periods of time, on a lake wide scale, by simulating the 3–dimensional flow regimes of the lake.

(b) Develop hydrodynamic dispersion models to track fully 2–dimensional (depth averaged) dynamic contaminant discharges to the connecting channels of the Great Lakes.

Application: In the case of accidental or event discharges of contaminants to lakes or rivers, the Ministry needs to assess potential impacts on drinking water intakes and on the aquatic environment.

Contact: Mr. P. Nettleton (416-323-5142)

OBJECTIVE 2

Improve process parameters that control the partitioning of contaminants between sediments and the water column and the speciation/chemical transformations of contaminants.

Background: The fate of contaminants discharged into or deposited on lakes or rivers depends on many physical and chemical processes. A number of these processes, including adsorption-desorption phenomena and heavy metal speciation, are not well understood at present. To adequately address questions about the impact of discharges or the expected benefits from abatement activities, improvements in the parameterizations of these chemical and physical processes are needed.

Tasks:

(a) Investigate the processes which control the flux of contaminants to and from sediments of various types and sizes.

(b) Conduct research on the rates of chemical transformation of compounds in sediments and water and how this relates to weather and water chemistry.

(c) Study partition/speciation phenomena for heavy metals.

(d) Improve estimates of atmospheric wet and dry deposition of contaminants.

Application: The scientific studies described would permit better dose/effect calculations and subsequently improve decisions on how to abate problems in lakes and rivers. These models could also estimate how contaminant concentrations in sediments would change over time with or without remedial actions.

Contact:

Mr. P. Nettleton (416-323-5142)
Dr. D. Poulton (416-323-5133)

OBJECTIVE 3

To develop portable or transportable sampling methodologies for real-time monitoring of special gaseous pollutants (e.g., hydrogen fluoride, hydrogen chloride, 1,3-butadiene, vinyl chloride) with sensitivity of low concentrations.

Background: Real-time ambient data for special pollutants are now being collected using the mobile Trace Atmospheric Gas Analyzer (TAGA) units. However, only a certain number of two-week surveys can be conducted using the mobile TAGAs each year. The TAGAs are excellent in the identification of gaseous pollutants and acquisition of real-time data for a shorter duration. However, it is not cost effective to lock up a TAGA in one survey for a prolonged period. Therefore, real-time portable or transportable sampling methodologies for special pollutants are required for long-term monitoring.

Tasks:

(a) Development of real-time portable or transportable sampling methodologies for special gaseous pollutants with sensitivity of low concentrations (sub-ppb).

Application: In support of source abatement and compliance strategies. Data can be gathered over a longer period to determine the emission impact on local air quality.

Contact:

Mr. Gary De Brou (416-235-6157)
Mr. Andy Ng (416-235-5964)

OBJECTIVE 4

To develop real time stack emission monitoring methods for volatile and semi-volatile organic compounds and metals.

Background: Traditional stack gas sampling methods for the above noted materials are expensive and labour intensive. These limitations make it impractical to use stack testing programs to ensure long term compliance and to minimize emissions.

Tasks:

(a) Develop a real time stack gas emission monitoring system or equipment for volatile organic compounds that is inexpensive and/or not labour intensive.

(b) Develop a real time stack gas emission monitoring system or equipment for semi-volatile organic compounds that is inexpensive and/or not labour intensive.

(c) Develop real time stack gas emission monitoring systems for heavy metals such as lead, cadmium, chromium, beryllium, selenium, silver and nickel.

(d) Test systems in a stack and compare results to currently used methods.

Application: Would be applied to stack sampling programs where the chemical is expected to be in the stack gas or when sampling is required by the certificate of approval.

Contact: Mr. Gary Wong (416-323-5129)

OBJECTIVE 5

To design strategies and conduct studies that result in the identification of specific sources and attribution for airborne semi-volatile organic compounds (SVOCs).

Background: Current studies of airborne levels of SVOCs are limited to measuring the concentrations in ambient air at the receptor site. Effective control strategies (e.g., pollution prevention) are only possible if specific sources and their relative contributions can also be determined.

Tasks:

(a) Assess concentrations of dioxins and furans near suspected source industries such as steel mills; ambient concentrations combined with aerometric analysis may provide source attributions.

(b) Develop real-time PAH monitors with directional and space-limited sampling (e.g., laser based remote sensing over impossible terrain).

(c) Design strategies and adapt methods to determine the indoor airborne and surface (deposited) concentrations of various pesticides in the first 24 hours after lawn spray application.

Application: Allows pollution control or prevention strategies to be applied where need is greatest.

Contact:

Dr. R. Chapman (416-323-5143)
Dr. G. Diamond (416-323-5212)

OBJECTIVE 6

To determine environmental pathways and fates of Semi-Volatile Organic Compounds (SVOCs) so that pollution prevention, control and remediation programs can be accurately targeted.

Background: Most SVOCs follow a complex path through the environment between point of origin and stable (long term) receptor site. Better understanding of the environmental pathways can identify more opportunities for pollution prevention and control, and may alert scientists to situations where ecosystem health (e.g., fragile egg shells) or human health (e.g., bioaccumulation in human fatty tissue) are endangered.

Tasks:

(a) Determine of mechanisms and rates of atmospheric reactions involving SVOCs such as PAHs, PCBs and organo-chlorine pesticides.

(b) Develop methods for measuring PAHs suspected of causing human health effects; compounds such as chlor-, thio- and oxy-PAH are of special interest.

(c) Determine the role played by volatilization of SVOCs from bodies of water in the Great Lakes Basin.

(d) Devise strategies and studies to reconcile ambient air measurements of SVOCs and calculated levels based on emission inventories.

(e) Determine the distribution of SVOCs between the gas phase and particle phases, both at the point of emission and as the plume travels downwind.

(f) Determine the most appropriate surrogates (or tracers) for characterizing the SVOC groups in various situations (such as phenanthrene for gas phase PAH, or benzo(a)pyrene for particle phase PAH).

Application: MOEE programs of pollution prevention, control and remediation can be applied in the most cost-effective fashion.

Contact: Dr. G. Diamond (416-323-5212)
Mr. D. Orr (416-323-5177)

OBJECTIVE 7

To design, develop and conduct studies in personal exposure to airborne toxics in order to address human health implications.

Background:

A proper risk assessment cannot rely solely on outdoor monitoring data to represent personal air quality and exposure profiles. Concentrations of airborne toxics in a person's inhalation (breathing) zone are often several times higher than those reported from outdoor measurements and people normally spend less than 10% of their time outdoors. For acute (inhalation) health investigations, a more accurate approach to risk assessment, cost-effective abatement strategies and setting of environmental standards, realistic personal exposure information is urgently needed.

Tasks:

(a) Develop new portable/personal air sampling methodologies, including real-time analysis where possible, for:

- polycyclic aromatic hydrocarbons (PAHs), pesticides and radon;
- hexavalent chromium;
- classical contaminants such as NO_2, O_3, and CO.;
- inhalable size fractionation of airborne trace metals and particulate;
- passive sampling techniques (e.g., badges), for all contaminants.

(b) Assess personal exposure in areas where exposure is potentially large due to suspected higher contaminant concentrations or known periods of long exposure. Suggested key areas would include schools and other institutions where children and the elderly are confined for many hours each day. Bowling alleys and bingo halls are examples of important private property situations that involve large numbers of people, long exposure periods and tobacco smoke.

Application:	In support of risk assessment situations; reduction of public (human) health effects, especially for susceptible populations.
Contact:	Dr. R. Chapman (416-323-5143) Mr. R. Bell (416-323-5171)

OBJECTIVE 8

To develop an air toxics release profile from industrial transportation, agricultural, residential and commercial sources in the Ontario Great Lakes Region in support of the Canada-Ontario Agreement (COA) on the Great Lakes.

Background:

In support of the Canada-Ontario Agreement on the Great Lakes, there is a need to assess the releases and deposition of target air toxic pollutants into the Great Lakes. Such information will be needed to implement voluntary elimination/reduction program, to support research program and standard setting or regulatory initiatives.

Studies have shown that as much as 80% - 90% of some of the toxics deposition in the Great Lakes are from air releases. Only limited and selective studies have been done on the assessment of air toxics released from industrial, transportation, agricultural, residential and commercial sources in Ontario such as the Windsor Air Quality Study. The compilation of the air toxics releases around the Ontario Great Lakes Region in the 1990s will be needed for various MOEE programs and initiatives.

Tasks:

(a) Analysis of industrial transportation, agricultural, residential and commercial sources in the Ontario Great Lakes Region to determine the relationship between the source activities and the air toxics releases.

(b) Review, investigate and develop methodology applicable to the compilation and assessment of air toxics releases using available source information.

(c) Develop the air toxics release database for the air toxics and methodology for future revision of the profiles.

Application:

Provision of a comprehensive air toxics release profile for the Ontario Great Lakes Region, a source and air toxics release relational database, a methodology for release inventory update.

Contact:

Mr. Peter Wong (416-235-6130)

OBJECTIVE 9

Develop improved chemical and physical modules for regional and urban oxidant modelling and test the model for finely resolved grids.

Background:

Ontario's one hour average ozone criterion of 80 ppb is exceeded at times during the spring and summer for nearly all locations in Southern and Central Ontario. At most monitoring sites, ozone is the compound responsible for the majority of the hours during which the Ministry's Air Quality Index exceeds 31. Ambient air concentrations of ozone are the net result of both regional and local emissions of NO_X and VOCs undergoing photochemical and physical processes. The complex interactions resulting in ozone production and scavenging make it difficult to evaluate the effectiveness of emission control measures in reducing ground level ozone. Improvements in our understanding of ozone production are needed to allow more certain assessments of the benefits of NO_X/VOC emission reductions on ozone concentrations.

Tasks:

(a) Investigate possible numerical interactions between chemistry, transport/diffusion and model grid size in predicting peak ozone concentrations in air quality models.

(b) Model studies of the effects of over lake transport of urban plumes on ozone concentrations over the lake and at nearby inland sites.

(c) Use measured and model results to assist in the development of an improved chemical module for ozone formation and the subsequent evaluation of the improved model.

(d) Investigate natural VOC emissions and the role they play in producing ozone for various NO_X/VOC ratio's in urban plumes or in overall regional air masses.

Applications:

A primary objective of this work is to provide more confidence in the model runs used to develop a cost effective NO_X/VOC emission control strategy for Ontario. Scientifically defensible model runs are required for Ontario to be able to comment on proposed emission control strategies in states to the south and west of

Ontario. An emission control strategy might be beneficial in one region but produce little benefit or higher ozone concentrations elsewhere.

Contact: Dr. R. Bloxam (416-323-5073)

OBJECTIVE 10

Establish data sets to aid in understanding ozone production and subsequently developing/evaluating air quality models which predict ozone concentrations.

Background:

Because of the complex photochemistry and scavenging processes leading to observed ozone concentrations, measurements of not only the original precursor species but the secondary compounds are needed to assess our knowledge. Detailed speciated measurements can be compared with model results to aid in the development of improved chemistry mechanisms. The adequacy of the model chemistry can have a significant impact on the relative importance of NO_x and VOC emission reductions on local and regional ozone concentrations.

Tasks:

(a) Establish high quality data sets to study the chemistry of ozone formation and the scavenging of ozone in regional air masses and/or in urban plumes. In combination with model runs, these data can assist in the development of improved chemical modules. These data sets also can be used in model evaluation as well as analyzing the data sets for effects such as the aging of urban plumes.

(b) Develop data sets to capture over lake ozone concentrations and assess how elevated ozone pockets might affect inland areas. These data sets could be used in combination with model runs to help evaluate the adequacy of the modelled ozone production and scavenging mechanisms.

Applications:

Speciated field observations of VOCs, NO_x and oxidants would assist in developing better oxidant models and in evaluating those models. These data can lead to improved understanding of ozone formation and subsequently provide more confidence in predictions about the impact of emission changes.

Contact:

Dr. N. Reid (416-323-5224)
Dr. W. Chan (416-323-5201)

OBJECTIVE 11

To investigate and develop a method of real-time qualitative and quantitative monitoring of selected volatile organic compounds and air toxics using non-point, long path or remote sensing device/system.

Background:

Ground level ozone formation as a result of a complex series of photochemical chemical reactions in the atmosphere, involving the oxides of nitrogen and volatile organic compounds (VOC). It is not possible to design an effective control strategy for the control of NO_x or VOC unless the details of the components of VOC in an airshed are monitored.

Current available VOC data are obtained at several selected urban sites located throughout Ontario using chemical cartridge collected over a 24 hour period every six days. The development of a realtime VOC database for various species from an airshed using non-point, long path remote sensing device/system will improve our understanding of ozone formation especially the urban photochemical smog and the source(s) and receptor relationship.

Aside from the research needs of the NO_x/VOC control strategies, the development of air quality standards and guidelines to protect human health will require better air quality information for the assessment of exposure to air toxics. The concurrent development of a realtime database for selected VOC species in an urban airshed, e.g., benzene, toluene and formaldehyde, which are also considered as air toxics will provide the much needed data for the formulation of risk assessment initiatives.

Tasks:

(a) Investigate the availability of non-point, long path or remote sensing technology and methodology that can be used to characterize the realtime ambient VOC concentration in an urban airshed.

(b) Using selected technology, develop the qualitative and quantitative methodologies and procedures that are applicable for individual, group or class of VOC e.g., aldehydes, ketones, aromatics, chlorinated or non-chlorinated aromatics.

(c) Apply the methodologies and procedures to the development of realtime speciated data for the speciated VOCs in selected urban airshed(s).

(d) Perform data analyses for selected VOC species, group or classes demonstrating the applicabilities to the NO_X/VOC control strategies and ambient air quality guideline or standard assessments.

Application: The outcome of this work will be an improved understanding of the NO_X/VOC photochemical formation in an urban airshed, better VOC information for the design of NO_X/VOC control strategies and for the development of air toxics guideline or standard.

Contact:

Mr. P.K. Misra (416-235-5768)
Mr. Peter Wong (416-235-6130)

OBJECTIVE 12

To determine the relative importance of NO_X, anthropogenic VOC and biogenic VOC in the formation of ozone. Also, to determine whether recent reductions in the emissions of the chemicals that produce ground level ozone have had any effect on ambient concentrations of ozone.

Background:

Ground level ozone is a hazard to human health, and causes damage to agricultural crops. It is formed as the result of a complex series of chemical reactions in the atmosphere, involving the oxides of nitrogen and volatile organic compounds (VOC). These reactions occur only in the presence of sunlight. Because of the complexity of the reaction sequences, it is not possible to select an effective control strategy unless all of the details are understood. For example, reductions in the emission of NO_X, one of the precursors, can, in certain circumstances, lead to increased concentrations of ozone. To complicate the picture, naturally emitted VOC are highly reactive with respect to ozone formation, but are not easily controlled.

Monitoring the effectiveness of ozone control measures is difficult because it is often masked by the larger effects resulting from year to year meteorological variability. It is therefore very important to have a better understanding of the role of meteorology in ozone formation and to develop methods of removing the meteorological dependence of ozone concentration, thus leaving the changes (if any) due only to emission changes.

Tasks:

(a) Analysis of data to determine inter-relationships between chemical and meteorological parameters and ozone formation.

Application:

The outcome of this work will be an improved understanding of the factors causing high ozone levels in Ontario, and is therefore of great importance in the development of control strategies under the NO_X/VOC Management Plan.

Contact:

Mr. D. Fraser (416-235-5771)
Mr. D. Yap (416-235-5773)

OBJECTIVE 13

To investigate and develop methodologies of applying remote sensing information on the temporal and spatial analysis of ground level air pollutants in Ontario.

Background: In support of the Canada-Ontario Agreement on the Great Lakes, NO_X/VOC Control Strategies, Global Warming Greenhouse Gases and other MOEE air management programs, there is a need to develop methods of assessing the temporal and spatial distribution of ambient air pollutants over the provincial domain. The application of remote sensing technique has the advantage of large spatial coverage and frequent surveillance information update. Data from the infrared, near infrared and visible bands are readily available from several Canadian and U.S. satellites and airborne data.

Tasks:

(a) Review, investigate the availability of the satellite and airborne imageries applicable to the direct or indirect assessment of ground level air pollutants.

(b) Develop methodologies to establish the relationship between the absorption bands and the target pollutants.

(c) Establish temporal and spatial profiles for target pollutants for Ontario.

Application: Provision of a quasi-realtime spatial coverage of air pollutant(s) in Ontario enhanced by remote sensing technique. Environment data and information enrichment applicable to various wide area air management strategies.

Contact:

Mr. Ming Lee (416-235-5777)
Mr. Dave Yap (416-235-5773)

OBJECTIVE 14

Use physical models to develop a better understanding of the dispersion of atmospheric pollutant releases near buildings and river flows into lakes.

Background:

The Ministry very often has to assess the potential impact of emission sources on or near buildings when issuing Certificates of Approval. The models available for such calculations need to be improved to reduce large under or overestimates of impacts which can occur with current models. When building shapes are very complex even the best possible analytic model would not accurately predict concentrations. Similarly, physical modelling in water channels could improve our estimates of shoreline contamination.

Tasks:

(a) Perform wind tunnel simulations for dispersion near buildings of various shapes and sizes to provide data to develop and evaluate air regulatory models.

(b) Conduct physical modelling of the dispersion of water plumes through various outflow configurations into connecting channels.

Applications:

The scientific studies described above could be used to evaluate/ improve current analytic or numerical models used in these situations. This has significance for air Certificate of Approvals or environmental audit studies and for assessing shoreline contamination due to outflows from rivers or channels.

Contact:

Mr. H. Sahota (416-323-5075)
Mr. P. Nettlelton (416-323-5142)

OBJECTIVE 15

To assess the need for stack emission controls and to provide information for assessing the effectiveness and appropriateness of proposals submitted by users of such technology.

Background:

The Ministry of Environment and Energy is placing increased emphasis on the use of non-incineration technologies for disposal or destruction of biomedical wastes. As a result, proponents are coming forward with new and developing technologies to treat biomedical wastes.

As most of these involve some form heat application and shredding, there is some concern that there could be some volatilization of organics and the release of odours and infectious organisms. Equipment for these non-incineration technologies generally does not have any pollution control and the companies have very little data on their emissions.

Tasks:

By performing the following tasks, develop a data base of emission levels of contaminants expected from the various technologies.

(a) Do emission testing of a large scale autoclave, a microwave unit and a chemical treatment unit.

(b) Collect emission data from equipment suppliers, process users and USA regulating authorities.

(c) Parameters of interest include but are not limited to: particulates, odours, volatile organic carbon, chlorine, particulates and viable organisms.

(d) Review data bank information and assess point-of-impingement levels for a representative stack (same stack for each process).

(e) Based on results of (d) review typical control technologies and estimate appropriateness of the equipment and the removal efficiency.

(f) Prepare a report on the project which includes all of the data gathered, calculations made, equipment design assumed, wastes being treated and references.

Application: In support of new biomedical regulations and policy.

Contact: Mr. G. Donnelly (416-323-5130)

OBJECTIVE 16

To assess the potential toxicity of sub-surface contaminants on human and ecological receptors and to characterize the potential exposure pathways involved.

Background: The presence of contaminants in soil is a major concern with respect to human and ecological exposure. Removal of contaminants to acceptable disposal sites is very expensive and occupies space at the site. One alternative is to base the remediation criteria on relevant receptors and exposure pathways, retaining consistent environmental protection even if sub-surface layers have higher concentrations that at he surface.

The concern with this approach is being able to provide assurance that the chemical constituents will remain in place and are out of contact with sensitive receptors. Associated with this is a need to know more about how sub-surface contaminants behave (transport, degradation, formation of toxic products) and how biological systems respond to their presence (root penetration, soil organism response).

Tasks:

(a) To assess at suitable sites the environmental behaviour and potential toxicity of contaminants in sub-surface soils. This should include the potential for human and animal exposure and for recycling though deep-rooted plants a well as the transformation and transport of the contaminants as a function of soil properties, topography and drainage of the site.

Application: Such information should be suitable for use in mathematical models for estimating the exposure. The models can be use in exposure pathway decisions as part of a site-specific risk assessment procedure or to modify generic sub-surface criteria.

Contact: Mr. R.G. Pearson (323-5102)

OBJECTIVE 17

To investigate the sources, movement and fate of total and faecal coliform bacteria in groundwater.

Background: During 1991-92 two surveys of 1,300 domestic farm wells and 144 multi-level monitoring wells, located in rural Ontario, were conducted. The majority of the domestic wells (900) were located in areas of intense agriculture on the most common soil types and on farms involved with the most common agricultural land-use practices. The remainder of the wells were located in less agriculturally intense areas including Northern Ontario.

The multi-level wells were located in areas of intense agriculture, predominantly in sandy, permeable soils. They were installed in agricultural fields of woodlots adjacent to the domestic wells.

The surveys indicated that approximately 34% of the domestic wells tested exceeded the acceptable concentration for total coliform or faecal coliform bacteria. Similarly, approximately 32% of the multilevel wells tested indicated groundwater contamination with total coliform or faecal coliform bacteria.

At the majority of sites, the concentration of bacteria in the multi-level wells were similar to those observed in the domestic water wells, indicating a clear correlation between the groundwater contamination found in farm wells and those found in adjacent farm fields. However, the application of manure to a given field did not appear to correlate with higher bacteria concentrations in the majority of wells nor closeness to a septic system seems to impact the results. Further, when the concentration of coliform bacteria from a multilevel well and a corresponding multi-level in a woodlot were compared, levels of bacteria were very similar.

Task: To provide the sources, movement and fate of total and faecal bacteria in groundwater in areas of intense agriculture.

Application: Groundwater contamination by total and faecal coliform bacteria is a major problem that has been found to impair a large percentage of water wells in rural Ontario. A better understanding of the sources, movement and fate of these bacteria will be of great benefit in designing a comprehensive solution to this problem.

Contact: Dr. Ken Roberts (416-235-6250)

OBJECTIVE 18

To develop a test procedure to determine the environmental toxicity of treated soils.

Background:

The treatment of contaminated soils will increase with the release on the Ministry of Environment and Energy's new criteria for treated soils. The criteria will vary depending upon the proposed disposal site and the future uses of that site.

There are a wide range of treatment technologies currently being developed for contaminated soils. The contaminants can be organic and/or inorganic materials.

The quality of the treated soil will be highly dependant on the level of contamination, the type of contamination and the treatment used. As a result, determining whether a soil has been adequately treated will be very important. It will be even more important if the soil is treated in-situ.

Tasks:

(a) Investigate existing results from research projects in this field (e.g., RAC Project No. 525 "Development of bioassay protocols for toxicants in soil") and from other jurisdictions (e.g., CCME, USEPA) and their relevance to treated soils.

(b) Where gaps occur in the testing technology, determine alternative test procedures that are used in other jurisdictions.

(c) Assess whether testing can be done in-situ or in the field.

(d) Determine how to obtain representative samples from the various forms of treated soil including those soils treated in-situ.

(e) With representative soil samples do analyses and assess effectiveness of testing protocols whose validity for the treated soils is questionable.

Application: Tests would be applied to treated soils to determine if the soils are acceptable for disposal in the area selected by the proponent. MOEE could designate specific test protocols in certificates of approval.

Contact: Mr. Gilles Castonguay (416-323-5214)

OBJECTIVE 19

To mitigate *acid mine drainage* to prevent damage to large areas of the aquatic and terrestrial environment.

Background:

A subset of mining sites in Ontario have waste rock, tailings (mill wastes) and mine workings that generate acids. The low pH associated with the reaction solubilizes toxic metals which are carried off the property. During operations, acids are neutralized to prevent impairment of water courses. After mine closure, passive systems are required to prevent acids from polluting the environment.

In 1988, spurred by industry, a national research organization called MEND (short for Mine Environmental Neutral Drainage) was established to oversee and coordinate research into acid mine drainage. In Ontario, research efforts related to acid mine drainage have been extended through an industry/government/university committee called MEND-Ontario (MEND-O). MEND-O works in close cooperation with the national body to ensure that overall goals are met.

There is a definite need to provide a comprehensive, scientific, technical and economic basis for the mining industry and government agencies to predict with confidence the long-term management requirements for reactive tailings and waste rock. Also, techniques should be established to enable the operation and closure of acid generating tailings and waste rock disposal areas in a predictable, affordable, timely and environmentally acceptable manner.

Tasks:

(a) Develop predictive techniques to determine the nature, mechanisms and extent of acid production in various environments.

(b) Develop methodologies to prevent and control acid mine drainage from tailings, waste rock and workings.

(c) Develop new methodologies to monitor operating, rehabilitated and abandoned acid generating sites.

(d) Ensure timely transfer of information on acid drainage research to assist industry and government to solve the overall problem.

Application: Environmental protection from acid mine drainage.

Contact: Mr. D. Bazinet (705-670-3246)
Mr. G. Miller (705-476-0207)

GOAL VII:

TO DIVERT FROM DISPOSAL AT LEAST 50%, BY THE YEAR 2000, THROUGH *WASTE REDUCTION, REUSE AND RECYCLING*, COMPARED TO 1987 AS A BASE YEAR

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OBJECTIVE 1

To identify key barriers that prevent individuals and corporations from participating in 3Rs activities and to determine how knowledge of such barriers can be used to advantage in the design and implementation of effective policies and programs.

Background: Much of the growth of Ontario's 3Rs infrastructure depends on the active participation of individuals and corporations in new approaches and projects. Most new approaches have involved a lengthy growth period or a participation plateau that could be overcome with a better understanding of the factors that limit earlier involvement in projects. The implementation of 3Rs activities faces a number of real or perceived barriers that dissuade individuals and corporations from participation despite a recognition of environmental benefits. Many reluctant parties ultimately participate after observation of other participants. Better knowledge of key barriers and motivating factors would assist the Ministry in the more effective design and delivery of policies and programs.

Tasks:

(a) Determine key barriers that affect individuals and corporations (municipalities, companies, institutions) from early participation in or acceptance of 3Rs activities such as the use of composters (backyard, central), user fees, use of secondary materials and waste reduction practices.

(b) Provide an analysis of options that have been used effectively in overcoming barriers and the different relative importance for different parties.

Application: Results of this research will be used to focus resources on identified barriers in the design and implementation of new activities, reducing program implementation time frames and increasing program effectiveness.

Contact: Mr. Neal Ahlberg (416-325-4433)

OBJECTIVE 2

To determine the chemical and biological species emitted from composting operations and to assess the potential environmental and health impacts with and without control mechanisms.

Background: Provincial diversion goals depend on increased use of composting and public concerns on the safety of such facilities delays implementation. Objective information and analysis of emissions and control mechanisms would assist in gaining public acceptance for composting and ensure that appropriate controls are in place for any emissions of environmental or health significance.

Tasks:

(a) Determine the characteristics of emissions resulting from the operation of composting facilities (aerosols, odours, leachate) with particular attention to chemical and biological species of environmental and health significance.

(b) Assess the performance of control mechanisms on the emissions of chemical and biological species of environmental and health significance from composting operations.

Application: Results of this work will be used to provide objective information on the emissions from composting operations to assist in the design and timely implementation of operating facilities.

Contact: Mr. Brian Van Opstal (416-325-4435)

OBJECTIVE 3

To determine process changes necessary to incorporate mixed residential papers in paper products and building products traditionally not using such feedstock.

Background: The markets for mixed residential paper are limited by the technical capability of paper mills and building product manufacturers to use such material. Mixed papers represent a large portion of the waste stream, even with the current levels of recycling.

Tasks:

(a) Determine the characteristics of mixed residential paper fibres recoverable from the waste stream.

(b) Determine applications where the required properties are satisfied by the recoverable mixed residential paper fibres and test the suitability for selected promising applications.

Application: Results of this work will be used to identify new uses for mixed secondary papers which will provide market demand to collect such materials from the residential waste stream.

Contact: Mr. Bruce Wilson (416-314-4639)

OBJECTIVE 4

To determine the characteristics and rate of discharge of chemical species, of environmental significance, from the processing of secondary materials and their use in beneficial applications in soil.

Background: The use of waste materials as beneficial products in engineered and other soil applications raises questions on long term environmental impacts. Information on the characteristics and rate of emissions from processing and use will assist in determining appropriate uses for selected secondary materials (tires, processed tires, mixed residential wood wastes) applied to land for beneficial purposes.

Tasks:

(a) Determine the characteristics and rate of release of chemical species from tires, shredded tires, and crumb rubber under conditions simulating engineered applications or in keeping with good agricultural/horticultural practices for a range of soil conditions (soil type, pH, moisture). Identify appropriate conditions or limitations for use of these materials and the engineering parameters critical to effective use without adverse impact on the environment.

(b) Determine the characteristics of mixed residential wood waste and assess the potential for processing and management options (composting, land application) for use in soil.

Application: The use of waste materials on land for beneficial purposes will create additional markets for selected secondary materials that now are directed to disposal.

Contact: Mr. Bruce Wilson (416-314-4639)

GOAL VIII:

TO PROTECT THE ENVIRONMENT AND HUMAN HEALTH FROM THE IMPACTS OF *LANDFILLS*

GOAL VIII

TO PROTECT THE ENVIRONMENT AND HUMAN HEALTH FROM THE IMPACTS OF *LANDFILLS.*

OBJECTIVE 1

To develop a method to determine the typical amount and quality of landfill gas releases from Ontario landfills.

Background: The rate of gas release and the chemical make-up of the gases released from Ontario landfills are dependant on many factors including moisture content in the landfill; design (i.e., with and without gas control) and operation of the landfill; and the type of waste disposed of in the landfill. Knowledge of landfill gas quality and quantity is important in the evaluation of the health and odour impacts from landfills. In addition the data can be used to assess the potential for using the gas to generate energy.

The tasks noted below can be done as all one project or in separate parts.

Tasks:

(a) Development of an efficient and cost effective monitoring method to determine representative gas emission rates from a landfill area, including emissions from areas with and without final cover, cracks and fissures as well as open working faces.

(b) Gather landfill gas samples, ambient air samples and emission rate measurements from a number of Ontario landfills that represent a cross-section of landfill types and ages.

(c) Analyze gases for energy and health impact parameters (e.g., vinyl chloride) as well as odour content.

(d) Develop or refine a predictive computer model to determine site specific landfill gas and trace organic emission rates from areas with and without final cover, cracks and fissures as well as open working faces.

(e) Compare computer model projections with gas analyses results from actual landfills.

(f) Evaluation and comparison of the capacities of granular versus cohesive cover soils to attenuate gaseous contaminants in emissions to the atmosphere through landfill soil covers, and to determine the contribution of the surficial soil layer in each case.

Application: Evaluation of applications for new landfills and gas recovery projects as well as assessment of closed landfills to determine need for remediation.

Contact:

Mr. E. Loi (416-323-5146)
Mr. C. Bostock (416-323-5218)

OBJECTIVE 2

To protect human health and safety from the threat of explosion and fire when methane migrates in the subsurface from landfills.

Background: Municipal landfills continue to generate large volumes of landfill gas which is composed mainly of methane ranging in concentrations of up to 70%. Methane is particularly dangerous, because it's explosive in air when methane is between 5% and 15%, and oxygen is above 12%. After migrating in the subsurface into enclosed spaces, and being ignited by a spark or flame, methane from landfills has caused many explosions and fires. As part of its mandate to protect public health and safety from landfills, the MOEE regulates contaminants such as methane moving off site.

Tasks:

(a) To assess the risk of explosions that could be caused by methane from Ontario's landfills that pre-date the Ministry's land-use and engineered landfill policies and methane guideline.

(b) To develop improved methods and system designs for monitoring methane where it could or might move in the subsurface into enclosed structures and cause an explosion, by supporting innovative ideas in the areas of detection instruments, alarm systems and materials for equipment.

(c) To develop improved designs for methane control facilities by supporting innovative ideas in the areas of gas migration barriers and venting systems.

Application: In support of landfill safety programs.

Contact: Mr. Charles Bostock (416-323-5218)

OBJECTIVE 3

To verify and describe subsurface movement of phosphorus from domestic septic systems, in support of MOEE policies on lakeshore capacity and nutrient enrichment.

Background:

At present, lake managers develop estimates of lake carrying capacity as a function of phosphorus loading from domestic septic systems. Underlying these calculations is the "precautionary principle" in which managers assume that all domestic phosphorus load will, at some point, manifest itself as a change in water quality. An acceptable degree of change is deciding on and resultant residential capacity determined.

Advocates of lakeshore development challenge these assumptions, or propose systems to prevent phosphorus' movement. Thin soils and bedrock geology predispose lakes on the Precambrian Shield to phosphorus enrichment from septic systems, yet make monitoring such enrichment difficult. Positive monitoring results and protocols would prove useful in support of our policies.

Tasks:

(a) Review relevant literature and summarize the evidence supporting or refuting the subsurface movement of phosphorus from domestic septic systems.

(b) Report on various alternatives for monitoring such effluent, their relative probabilities of success and their cost effectiveness.

(c) Develop a monitoring protocol from among the alternatives that is best suited to conditions on the Precambrian Shield.

(d) Conduct monitoring at various sites differing in phosphorus loading to septic systems, geology, soil characteristics, slope and vegetation.

(e) Report on the relative movement of phosphorus at each site and on the feasibility of routine monitoring for phosphorus movement from shoreline septic systems.

Application: Positive monitoring results would be extremely useful support of MOEE shoreline development policies. Acceptable negative results would be useful feedback for future policy development. An effective monitoring protocol would be a useful tool for use by abatement staff.

Contact: Mr. Neil Hutchinson (705-766-2418)

GOAL IX:

TO ASSESS THE *POTENTIAL APPLICATIONS OF WASTE*

GOAL IX

TO ASSESS THE *POTENTIAL APPLICATIONS OF WASTE.*

OBJECTIVE 1

To develop appropriate groundwater guidelines for the application of hauled sewage and the value of available guidance information (i.e., the Manual of Policy, Procedures and Guidelines for On-site Sewage Systems (MOEE), Chapter 13).

Background:	Numerous proposals are received every year for the disposal of hauled sewage by way of land application. MOEE Part VIII guidelines for the protection of groundwater resources relate specifically to subsurface sewage disposal. As such, soil conditioning, crop uptake, etc. are not considered when assessing the potential for groundwater impacts.
Tasks:	By evaluating shallow groundwater quality at various disposal/soil conditioning sites, the attenuation of sewage constituents can be assessed in relation to application rates, environmental conditions i.e., soil conditions, unsaturated overburden depth, topography, vegetative cover, etc., and site hydrology.
Application:	By completing a comprehensive assessment of the collected information appropriate groundwater guidelines for on land application of hauled sewage can be developed.
Contact:	Ms. Debbie Jenkins (705-670-3242)

OBJECTIVE 2

To design, develop and demonstrate cost-effective strategies for the detoxification and beneficial reuse of solids generated by water and wastewater systems.

Background: Solids generated in Ontario by water and wastewater plants are generally not acceptable for use as fertilizers or soil conditioners. Wastewater plant biosolids are disposed of by various different means including landfill and incineration. Drinking water plant wastes are landfilled, disposed of into the sewer or returned to the receiving water. Recent work on water plant waste suggests that the sludges produced from iron-based coagulants are useful conditioners for iron deficient soils.

Tasks:

(a) Develop new and assess existing techniques for removal and reuse of metallic coagulant residues from water plant sludges.

(b) Demonstrate methods of detoxification of wastewater sludges.

(c) Evaluate the potential for use of detoxified water and wastewater plant sludges as soil conditioners.

Application: In support of waste reduction and "3Rs" initiatives, the potential for beneficial use of nutrient-rich sludges. Applications may include the use of water treatment chemicals that are more amenable to recovery and reuse.

Contact: Mr. Dale Henry (416-235-6303)

OBJECTIVE 3

To identify non-agricultural land application programs currently practised and determine the beneficial use of water treatment plant residuals, in order to minimize the ultimate cost to the customer and improve the environment with an economic return.

Background: Water purveyors, in the process of providing potable water for their customers, produce as a by-product of the treatment process a considerable amount of residuals. The majority of these residual in the past have either been returned to the receiving stream, sewer or landfill. In light of the increasing regulatory burdens, scarcity of landfill capacity, and the cost for landfill and sewer disposal, the water industry should embark on an aggressive program of identifying beneficial uses of which non-agricultural land application of residuals merits attention.

Task:

- Literature review and utility survey to document all non-agricultural land application practices currently being employed including:
  - technical feasibility;
  - regulatory constraint;
  - public acceptance;
  - cost savings; and
  - long-term effects.
- Conduct field survey and site visit/interview.
- Screen/prioritize alternatives that show the most promise for the water utilities for residuals disposal/use.
- Determine the desirable characteristics of the residuals (including constituents, quantities, solid concentration, etc.) for the specific non-agricultural land application method identified.
- Conduct a multi-year field-scale demonstration project involving non-agriculture land application.

The proposal should allow investigators to propose research on such application as:

- forest land;
- turf application;
- dust suppression;
- landfill cover;
- land reclamation; and
- topsoil blending.

Evaluation criteria should centre on research methodology, satisfying regulatory requirements and applicability.

Application: Prepare a guidance manual to assist utilities for determining the best non-agricultural land application strategies, including but not limited to the following:

- forest land;
- turf application;
- dust suppression;
- landfill cover;
- land reclamation; and
- topsoil blending.

Contact: Dr. Ken Roberts (416-235-6250)

OBJECTIVE 4

To evaluate the mobility of chemical constituents of coagulant residuals in land applications.

Background:

This project is critically needed for the water industry since final disposal of residuals has been a problem and will become more of a problem when more specific chemicals are treated, e.g., radionuclides, is required.

The evaluation will be performed in accordance with procedures used for assessing wastewater sludge and will address "aging effects", impacts on groundwater, surface water, and plant growth. All water utilities will benefit from this project to design land application reuse and/or disposal systems for coagulant residuals and to provide valuable information so that utilities can deal with regulatory agencies and public interest groups.

In general, aluminum and iron coagulant residuals and their interactions with a wide range of soil types should be evaluated. Soil types should cover a broad range of geographical areas, considering soil clay/silt/sand distributions and organic content. Use of standardized soil sample should be considered. Residuals should be analyzed for specific constituent contents (e.g., heavy metals, parasites, nitrogen and phosphorus specification, organic matter). Where possible, an attempt should be made to identify the source of these constituents within the treatment plants (e.g., raw water, chemicals added, etc.).

Tasks:

- Experimental and analytical testing should address the chemical means by which constituents are bound in coagulant residuals.
- Surface adsorbed, organically bound, and chemically precipitated heavy metal constituents should be differentiated; mobility from each fraction should be assessed.
- Nitrogen and phosphorus availability for plant uptake should be measured as well using bench-scale test procedures.
- Nitrogen mineralization should be determined.

- Consideration should be given to the mobility of cysts and oocyst in the residuals and their viability under different sludge or environmental conditions.
- Effects of residuals "aging" on constituent mobility should be a prime variable in the experimental test matrix.
- A bench-scale test protocol for quantifying residuals interactions with soil systems should be developed.
- Studies should identify specific crops or grasses that would be used as indicators of potential problem conditions (e.g., excess metal uptake, lack of nutrient availability).
- The protocol should be field tested and correlated against operating land application rates to determine appropriate residual application rates to soil systems.

Application: Addresses the final disposal of water treatment plant wastes/residuals.

Contact: Dr. Ken Roberts (416-235-6250)

OBJECTIVE 5

To provide for the safe management of de-inking sludges and to minimize emissions from its incineration.

Background:

Large amounts of de-inking sludges are produced in Ontario with the amounts on the increase as more and more waste paper is recycled. The Atlantic Packaging plant produced 100,000 tonnes of de-inking sludge in one year. Some of this sludge is spread on land but as quantities increase, the available land decreases and sludge quality limits tighten there could be an increased reliance on sludge incineration.

The Ministry of Environment and Energy has concerns with incinerator emissions but operating parameters for de-inking sludge incinerators have not been developed. Incinerator technology, operational parameters and methods of operation are significantly different than municipal solid waste or hazardous waste incinerators.

Full-scale pulp and paper mill sludge incinerators in Ontario are not suitable for a test program due to their use of multiple fuels, size and lack of operation variability. Use of such a facility would result in prohibitively expensive modifications and testing. New facilities would likely use state-of-the-art fluidized bed incinerators; thus, testing on existing full-scale units would be irrelevant.

Tasks:

By performing the following tasks, develop optimal operating parameters to minimize emissions:

(a) Do chemical analyses of typical sludges with an emphasis on dioxins/furans and heavy metals.

(b) Do leachate toxicity analyses of the fluid bed incinerator ashes.

(c) Test burn samples of typical de-inking sludge under various operating conditions of temperature and retention time to determine typical emissions such as particulates, carbon monoxide, carbon dioxide and oxygen.

(d) Recommend further development and testing that utilizes up to three wood and/or sludge burning projects now being developed by industry.

Application:	Information learned would be incorporated into MOEE policy and/or regulation. As well, data would be used by MOEE staff during the review of an application for a certificate of approval for such an incinerator.
Contact:	Mr. Gord Donnelly (416-323-5130)

GOAL X:

TO *ASSESS TECHNOLOGIES* IN TERMS OF COST EFFECTIVENESS IN SUPPORT OF ENVIRONMENTAL PROTECTION

GOAL X

TO *ASSESS TECHNOLOGIES* IN TERMS OF COST EFFECTIVENESS IN SUPPORT OF ENVIRONMENTAL PROTECTION.

OBJECTIVE 1

To develop new knowledge of the impact of stormwater and CSO discharges on the environment and to support and encourage the optimization and evaluation of new techniques and practices to manage, control and treat these discharges.

Background:

In spite of recent improvements in point source controls through programs like MISA, most urbanized areas are unable to attain water quality targets and restore beneficial uses without some control of stormwater and combined sewer overflow (CSO) discharges. This has been well documented in Pollution Prevention and Control Planning Studies and the development of Remedial Action Plans (RAPs).

Appropriate pollution control strategies for these discharges usually consist of a combination of capture and treatment technologies. Unfortunately, most solutions are usually very expensive and complex. In Ontario, both the development and testing of appropriate technologies is still in its infancy.

To ensure that these large remediation projects result in the maximum benefit to the environment, a great deal of research work is necessary. This work will provide both new information and new cost effective options for the best management and treatment of stormwater and CSO discharges.

Tasks:

(a) Improve the knowledge of the chemical composition and physical characteristics of these discharges.

(b) Identify the degree of environmental impact through detailed innovative effluent and receiving water assessments and enhance the ability to conduct such assessments.

(c) Optimize and evaluate the performance of new stormwater and CSO technologies and practices.

(d) Develop numerical models to assist in the design, optimization and siting of technologies.

(e) Develop new monitoring techniques for impact assessment and facility performance.

(f) Develop a monitoring protocol to assess the pre and post commissioning of implemented technologies and practices.

Application: The proposed research plan will improve our knowledge base and management options for stormwater and CSOs and thereby abate the existing environmental problems and prevent new ones from emerging.

Contact:

Mr. D. Henry (416-235-6303)
Mr. M. D'Andrea (416-235-6226)

OBJECTIVE 2

To conduct a comprehensive evaluation of alternative disinfection techniques for specific water and wastewater applications in Ontario.

Background:

The tendency for chlorine to form carcinogenic compounds when in contact with natural organic material has prompted regulatory authorities to reduce allowable concentrations of trihalomethanes and to consider regulating other chlorination by-products in drinking water. Certain organisms (Cryptosporidium spp.) have shown strong resistance to chlorination and there are indications that other pathogenic organisms found in water supplies may be developing resistance to chlorine.

Chlorine itself is toxic to aquatic organisms at low concentrations. Release of sewage plant effluents containing chlorine and organochlorine compounds can have significant negative effects on a receiving water. Sewage plant effluents that have not been disinfected sufficiently to inactivate pathogens may also negatively affect receiving waters.

There is a known risk to human health involved in abandoning the use of chlorine until carefully proven alternatives are found. Certain disinfection technologies are well established for specific applications, for example, ultraviolet irradiation for wastewater and ozonation for drinking water. These and other alternative technologies such as advanced oxidation processes should be evaluated in terms of their applicability to different operating conditions and source water types.

Tasks:

(1) Assess these techniques in terms of pathogen inactivation for specific operating conditions and source water or receiving water types. Limitations and costs of the various techniques must also be addressed.

(2) Information to be generated must carefully address by-product formation with an emphasis on human health risk assessment.

(3) A comprehensive applications manual for use in Ontario water and wastewater facilities should be the final product

of this work. This manual should include the applicability of various techniques under different operating conditions.

Tasks of follow-up research projects may include the bench-scale development of new disinfectants and techniques to deal with problems that existing methods can not accomplish.

Application:

The adoption of reduced health risk alternative disinfection techniques for drinking water treatment would reduce human health risks estimated to follow ingestion of trihalomethanes, haloacetic acids and other disinfection by-products. Wastewater effluent toxicity reduction by avoidance of halogenated organic by-product formation would have beneficial effects on receiving waters. Avoidance of both drinking water and wastewater treatment with chlorine indirectly will reduce stratospheric ozone depletion by reducing volatile organochlorine releases.

Contacts:

Mr. Brian Jobb (416-235-5827)
Mr. Tony Ho (416-235-6237)

OBJECTIVE 3

To identify and quantify the design and operation factors that optimize the bioremediation of contaminated sites.

Background:

The MOEE has revised the criteria for the decommissioning of contaminated soil sites with the result that there is expected to be an increase of the number of sites that are remediated.

Bioremediation of organically contaminated soils is one process that is anticipated to be frequently proposed. Development of the technology has occurred primarily in the U.S.A. and is now increasingly being proposed for Ontario sites.

Proposals include in-situ applications and remote treatment sites where waste is transported to and then treated. In some cases biological innoculums from outside of Ontario are to be injected into the contaminated soil.

Tasks:

(a) Review design and operational parameters for both in-situ and ex-situ bioremediation.

(b) Identify and quantify those parameters that can be controlled to optimize treatment efficiency and costs.

(c) Identify and quantify those parameters that could be significant in different parts of Ontario. Address how to optimize treatment efficiency for these parameters.

(d) Identify hazards and potential controls on the use of imported biological mixtures.

(e) Provide a protocol that will allow MOEE staff to evaluate the potential effectiveness of project.

Application:

In the review of applications for certificates of approval for bioremediation of organically contaminated soils.

Contact:

Mr. Gilles Castonguay (416-323-5214)

GOAL XI:

TO SUPPORT THE CORPORATE *POLICY DEVELOPMENT AND MANAGEMENT PROCESSES* THROUGH RESEARCH AND DEVELOPMENT OF ADVANCED MULTI-DISCIPLINARY METHODS TO INTEGRATE SCIENTIFIC, LEGAL, SOCIAL AND ECONOMIC INFORMATION IN POLICY DECISION-MAKING

GOAL XI

TO SUPPORT THE CORPORATE *POLICY DEVELOPMENT AND MANAGEMENT PROCESSES* THROUGH RESEARCH AND DEVELOPMENT OF ADVANCED MULTI-DISCIPLINARY METHODS TO INTEGRATE SCIENTIFIC, LEGAL, SOCIAL AND ECONOMIC INFORMATION IN POLICY DECISION-MAKING.

OBJECTIVE 1

To establish a basis for effective use of risk assessment and comparative risk information in environmental decision-making.

Background: Increasingly, information on risks to human health and the environment are being collected and used to support Ministry decision-making on such diverse topics as standard setting, site clean-up criteria, and Ministry program priorities. Given the evolutionary nature of the field of risk assessment it is important that the Ministry keep abreast of new methods and approaches, particularly those employed in other jurisdictions and that the Ministry foster consistent and sound use of risk information. It is also important that risk information be utilized in appropriate contexts and in proper relation to other factors (e.g., economic, social and legal).

Tasks:

(a) Synthesize and analyze information on applications, methods and experience in using risk information for corporate policy decisions in other jurisdictions.

(b) Examine other jurisdictions in Canada, the U.S. and Europe to determine what and whether specific risk thresholds are used to set ambient environmental and workplace health and safety standards; determine whether risk thresholds are formal (legislated or in regulation) or informal.

(b) Identify and critically assess opportunities for sound use of risk assessment in Ministry corporate policy functions.

(c) Identify and undertake trial applications of multi-disciplinary approaches to the collection and use of risk information in Ontario.

Application:

- Provide consistent basis and approaches for setting Ministry priorities.
- Provide stronger public rationale for Ministry regulatory and resourcing decisions.
- Assure rational use of risk information and appropriate integration into existing Ministry functions.
- Provide basis for explicitly selecting a risk level or threshold for use in developing standards or to defend a proposed standard.

Contact: Mr. Tim Gigliotti (416-323-4347)

OBJECTIVE 2

To undertake feasibility and design research for experimental or demonstration applications of economic instruments in Ontario.

Background:

Greater emphasis is being given worldwide to the use of economic instruments to assist governments in meeting environmental objectives. In the U.S. complex systems of emissions trading programs have evolved while, in Europe, various countries have instituted special environmental taxes. Ontario has implemented a few economic instruments (e.g., financial assurance, Tire Tax, Tax for Fuel Conservation) and has conducted internal analysis a number of other tools (e.g., effluent charges, NO_X permit trading). At this point in Ontario there is potential to carry a number of economic instrument concepts to a trial or demonstration stage. Research is required to determine the feasibility and design considerations for selected demonstration projects.

Tasks:

(a) In conjunction with MOEE identify program areas suited to demonstration of selected economic instruments.

(b) Undertake feasibility and design studies as lead-ins to demonstration projects (e.g., tradeable phosphorus allocations, user-pay garbage disposal, stormwater utilities, tradeable benzene utilization allocations). The experience of other jurisdictions and previous efforts in Ontario should be reviewed and evaluated.

(c) Identify likely candidate areas/locations for demonstration projects.

Application:

- Demonstrate practical feasibility of economic instruments.
- Moderate costs of command-and-control regulation.
- Facilitate flexibility of private sector decisions.

Contact:

Mr. Tom Coape-Arnold (416-323-4459)
Dr. Jack Donnan (416-323-4611)

OBJECTIVE 3

To determine the appropriate role for non-regulatory approaches to environmental protection as elements of an overall corporate policy framework.

Background: A number of non-regulatory approaches to environmental protection are open to governments working in conjunction with other sectors. These approaches include public education and awareness, technical advice and assistance, joint business ventures, voluntary memos of understanding, compliance information disclosure, product stewardship initiatives, and various forms of economic instruments. The relationship between non-legislated approaches and regulation is evolving. Research is required to evaluate experience to date, examine approaches in other jurisdictions, and better define the relationship between regulation and non-regulatory tools.

Tasks:

(a) Synthesize and evaluate experience in Ontario on the relationship between regulatory and non-regulatory mechanisms.

(b) Document and assess experience in other jurisdiction.

(c) Investigate legal implications of giving great emphasis to non-regulatory mechanisms.

(d) Define policy alternatives appropriate to Ontario.

Application:

- Moderate future regulatory and enforcement cost burden to MOEE.
- Identify innovative non-regulatory approaches transferable to Ontario.
- Contribute to climate of regulatory certainty.
- Provide clear policy definition of relationship between regulation and non-regulatory mechanisms.

Contact: Mr. Tim Gigliotti (323-4347)

OBJECTIVE 4

To develop and demonstrate indicators to measure environmental protection performance and environmental sustainability in Ontario.

Background:

Clear and consistent indicators are required to measure environmental protection performance, both for the private and public sectors. Increasing emphasis is being given in the private sector to incorporating environmental performance reporting within the context of annual activity and financial reports, investment prospectus, and corporate financial accounting. Within the public sector government agencies require consistent indicators to track program effectiveness, regulatory compliance, and customer service. Overlaid on these needs is the trend to the use of economic, social and resource characteristic indicators to measure long-term environmental sustainability and analyze policy directions (e.g., climate change, toxic substances, transportation and urban smog).

Tasks:

(a) Investigate potential environmental performance and sustainability indicators for key industry, government and societal sectors.

(b) Document and assess applications of performance and sustainability indicators in other jurisdictions.

(c) Identify indicators, including methods and data requirements, appropriate to Ontario.

(d) Undertake trial implementation and use of selected indicators.

Application:

- Provide means to monitor sectoral performance and overall sustainability of Ontario's environment inclusive of natural resource base, economic activities, energy flows and human influences.
- Support setting of Ministry priorities and long-term directions.

- Provide meaningful measures to augment biophysical state-of-environment information.

Contact: Mr. Tim Gigliotti (416-323-4347)

OBJECTIVE 5

To describe and assess the potential application of a reverse onus principle to the regulation of toxic substances.

Background:

Currently there is no onus on the producers and/or users of non-licensed chemical substances (e.g., substances other than food additives, pesticides, pharmaceuticals) to prove the absence of harm to the environment or human health before production or use. It has been suggested that for certain classes of chemical substances that the onus for such proof be on producers and/or users rather than on environmental protection agencies. Research is required to determine the practicality of reverse onus and to thoroughly assess the legal, economic, social and operational implications of a reverse onus policy on government, industry and other affected sectors.

Tasks:

(a) Document the legal and procedural situation in Ontario and other jurisdictions.

(b) Document and analyze the relationship between federal and provincial mandates, responsibilities and powers relative to reverse onus.

(c) Investigate and report on methods employed in handling scientific uncertainty in the context of reverse onus.

(d) Identify and report on implications of applying a reverse onus policy in Ontario.

Application:

- Potential reduction in MOEE standard setting and substance assessment cost burden.
- Protection of the environment from impacts due to inadequate prior assessment.
- Provide legal and procedural basis for Ministry policy direction.
- Reinforce principle of product stewardship.

Contact: Mr. Tim Gigliotti (416-323-4347)

OBJECTIVE 6

To develop practical measures for implementing a multi-media based approach to pollution prevention in Ontario.

Background:

Historically, Ontario and many other jurisdictions have approached environmental protection from a single medium perspective (e.g., air, water, land). MOEE is moving to a more integrated multi-media approach so that all media are consistently protected and so that inter-media transfers of pollutants are eliminated. A large number of ministry functions are potentially affected by this transition; for example, standard setting, abatement and clean-up planning, facility approvals, technical assessment, program development, environmental monitoring. Research is required to examine these functions and develop practical measures for implementing a multi-media based approach to pollution prevention in Ontario. In particular the research should examine the needs and opportunities for ensuring compatibility in approaches across functional lines.

Tasks:

(a) Document current media-specific functions in MOEE and attempts to achieve multi-media integration.

(b) Review and evaluate experience in other jurisdictions relevant to corporate-wide implementation of a multi-media approach.

(c) Develop potential practical approaches and measures which are appropriate to Ontario.

Application:

- Minimize occurrences of inter-media transfers of pollutants.
- Contribute to streamlining of customer service.
- Reduce duplication and overlap in ministry processes.
- Increase compatibility and credibility of Ministry functions.

Contact: Mr. Tim Gigliotti (416-323-4347)

OBJECTIVE 7

To establish a bank of potential initiatives which the Ministry could take in improving its relations with the First Nations on a government-to-government basis.

Background:

As the Ministry re-defines its relationship with First Nations across the province, as land-claim negotiations and self-government agreements are concluded, increasing pressure is placed on the Ministry to develop new ways of involving First Nations in a variety of decision-making processes, such as environmental assessments, EA hearings, certification of projects, inspections, monitoring, etc. It will thus become increasingly important for the Ministry to develop ways through which First Nations can be involved in decision-making processes in a way that meets the government-to-government criteria without compromising the Ministry's legal and common law mandates.

Tasks:

(a) Identify areas of critical importance to First Nations and the Ministry which may require initiatives to be taken.

(b) Undertake comparative analyses with other jurisdictions and/or policy fields.

(c) Develop scenarios for resolution for each area of critical importance.

Applications:

(a) In support of the work of the Joint Forum.

(b) Will provide guidance to program and operations staff in developing relationships with First Nations.

(c) Will support policy development.

Contact: Mr. Daniel Cayen (416-323-4260)

OBJECTIVE 8

To develop proposals on how to establish greater jurisdictional clarity as to what order of government has jurisdiction over what areas of environmental management and on how cooperation between the federal, provincial and aboriginal might be structured to ensure more effective environmental management.

Background:

There currently exists great uncertainty as to what order of government has jurisdiction over what aspect of environmental management on reserve and on recognized traditional territories. In addition, there is little understanding as to what order of government will exercise jurisdiction over the environment in the context of self-government and what structures will be put in place to ensure cooperation between the Federal, Provincial and Aboriginal Governments. This issue is particularly salient in the context of the definition of traditional territories and the signing of co-management agreements, such as is planned under the Shoal Lake watershed management agreement.

Tasks:

(a) Review existing legal opinions on jurisdiction.

(b) Undertake research in existing and emerging institutions relevant to the policy area.

(c) Undertake comparative analyses on legal regimes in other policy areas and other jurisdictions.

(d) Develop jurisdictional models for potential application.

Applications:

(a) Support MOEE discussions with the Federal and Aboriginal Governments on jurisdictional matters.

(b) Support MOEE input in self-government negotiations (e.g., White Fish, UIC and NAN)

(c) Provide greater clarity to operations and program staff as to their responsibilities and roles on reserve and on traditional territories.

Contact: Mr. Daniel Cayen (416-323-4260)

OBJECTIVE 9

To survey and Apply Methods to Quantify and Value Damages From Spills and Unplanned Releases of Contaminants.

Background:

Under the U.S. *Comprehensive Environmental Responses, Compensation and Liability Act* of 1980 (CERCLA), regulations have been promulgated which specifies methods to be employed for assessing environmental damages from oil spills. CERCLA provides two types of natural resource damage assessment regulations. Type A regulations provide a simplified approach, involving minimal field observations to be used for minor incidents, while Type B regulations describe methods for site-specific, natural resource damage assessments with potentially extensive field observations to be used for major incidents.

The Type A approach involves application of a systematic procedure for coastal and marine environments damage assessment which generates estimates of the physical fates of spilled petroleum, biological effects and damages, biomass reductions and economic values of damages and biomass changes.

These procedures have been applied to various marine oil spills in the U.S. and provide the basis for monetary damage awards over and above out-of-pocket clean-up costs.

Development of similar procedures for application in Ontario would aid in estimating the value of damages for spills which could be used by the Environmental Compensation Corporation and the Environmental Security Account Office in their activities and priority setting.

Tasks:

- Compile and evaluate methods to quantify and value environmental damages in terms of activities, uses and intrinsic values.
- Recommend practical methods or procedures for the Ministry to quantify damages caused by spills or other unplanned releases of contaminants and to estimate monetary values associated with these damages.
- Apply procedure to 10 different cases in Ontario.

Application: Will provide the Ministry with procedures and estimates which can be used to estimate damages caused by spills and other contaminant releases that can be used by the Environmental Compensation Corporation in calculating awards and by the Security Account to prioritize sites.

To be reviewed with the Environmental Security Account Office and the Environmental Compensation Corporation as potential partners.

Contact: Dr. Jack Donnan (416-323-4611)

OBJECTIVE 10

To assess the estimated greenhouse gas emission reductions in Ontario as a result of Canada's National Action Program (to be announced in March 1995). Contribute to the program design of climate change measures. Review economic impacts and cost-effectiveness of specific climate change initiatives.

Background: At the Conference of the Parties to the Framework Convention on Climate Change in March 1995, Canada will announce its national program to reduce emissions related to climate change, currently under development. Although estimates of reductions will be prepared on a national basis, the potential reduction in greenhouse gas emissions from these actions needs to be estimated for Ontario. Work will also be necessary in developing the specific measures following from the Program, including analysis of cost-effectiveness and economic impacts.

Tasks: The tasks should be undertaken using and extrapolating from existing data and studies from sources such as government, academic and other research organizations:

(a) Identify baseline greenhouse gas emissions rates in Ontario before implementation of reduction measures and estimate future greenhouse gas emissions in Ontario.

(b) Review the National Action Program and estimate the resulting reduction in greenhouse gas emissions in Ontario.

(c) Outline possible specific measures to reduce greenhouse gas emissions in Ontario based on the National Action Program.

(d) Estimate costs of implementing such measures, including their economic impacts on affected sectors, stakeholders, etc.

(e) Provide a hard copy report on the results, along with a user-friendly data base.

Application: To provide support for development of Ontario-specific measures to reduce greenhouse gas emissions.

Contact: Mr. Doug MacCallum (416-323-5645)

OBJECTIVE 11

To understand the expected energy impacts of climate change on Ontario, under different greenhouse gas emission scenarios. Impacts will include climate changes and resulting heating and cooling load changes, changes in hydro, solar, wind and biomass resources, and any other identified effects.

Background: Climate change will have impacts on energy supply and demand in Ontario. Preliminary analysis has indicated that increased temperatures may reduce winter heating loads but increase summer cooling loads. Other expected effects include reduced rainfall leading to reduced hydro-electric output. These effects are currently understood only in directional terms, with limited detail. The effect on production of biomass, available solar energy (cloud effects), or wind regimes in Ontario is not known. Long term energy planning will have to accommodate possible climate change effects. The range of possible impacts needs to be understood to assist in sound energy policy development.

Tasks:

(a) Review and interpret existing climate modelling research and projected impacts on Ontario.

(b) Elaborate on existing research or conduct further research as necessary to estimate climate change impacts on Ontario's energy supply and demand.

(c) Report on the expected effect of climate change on each identified component of energy supply on demand under varying scenarios of greenhouse gas emissions.

Application: Results of the study will be applied in developing Ministry policy on renewable energy and climate change. Findings will influence the outlook on the quantity of renewable energy that can reasonably be expected and the corresponding government policy on renewables. Findings may also influence the Ministry position on the need for action to address climate change.

Contact: Mr. Doug MacCallum (416-323-5645)

OBJECTIVE 12

To understand the elements of full-cost accounting necessary to compare renewable resources with conventional energy resources on an equivalent basis.

Background: Full-cost accounting has been advocated to incorporate environmental effects in energy planning, particularly as a mechanism to equalize consideration of renewable energy and conventional sources. Ontario Hydro and the gas utilities are attempting to incorporate some elements of full cost accounting in their Integrated Resource Planning processes. The Ministry needs to better understand the elements and implications of full cost accounting to provide policy direction to the Ontario Energy Board and energy utilities.

Tasks:

(a) Research and review existing literature and studies on full cost accounting and treatment of environmental externalities.

(b) Identify the key elements and issues related to full cost accounting applied in Ontario. Note possible treatments, and applications in other jurisdictions.

(c) Identify advantages and disadvantages to alternative approaches, including estimated impacts on Ontario utilities and energy prices.

(d) Prepare a discussion paper for general distribution summarizing full cost accounting approaches and impacts.

Application: The paper will be used to further understanding on full cost accounting applied to Ontario and assist in policy development on applications in Ontario.

Contact: Mr. Doug MacCallum (416-323-5645)

OBJECTIVE 13

To investigate and report on the legislative and regulatory hurdles to the production and/or use of electric vehicles in Ontario.

Background:

Electric vehicles have the potential to reduce air emissions associated with transportation. They have particular air quality benefits when utilized in urban areas that are subject to locally elevated levels of NO_x/VOC. Regulatory initiatives in other jurisdictions are pushing for the introduction of electric vehicles. The government has received proposals to develop electric vehicles in Ontario.

One of the identified barriers to electric vehicle development is existing vehicle regulations and standards. The Ministry needs to understand the barriers to the production of electric vehicles in Ontario and barriers to the use of electric vehicles in Ontario.

Tasks:

(a) Identify Ontario companies that at present undertake research on electric vehicle technologies, design these vehicles, or produce parts for electric vehicles, and other stakeholders with an interest in electric vehicles.

(b) With the assistance of those companies and stakeholders identify the legislative and regulatory barriers to the introduction of electric automobiles and light trucks in Ontario.

(c) Develop recommendations for addressing the identified barriers to the introduction of electric vehicles.

Application:

Results of the study will be applied in developing Ministry policy on a role for electric vehicles in reducing emissions and energy use in Ontario.

Contact:

Mr. Doug MacCallum (416-323-5645)

GOAL XII:

TO SUPPORT *LAND USE PLANNING*

GOAL XII

TO SUPPORT *LAND USE PLANNING.*

OBJECTIVE 1

To test the Cumulative Effects Monitoring Framework and Procedures Manual, recently developed for the Niagara Escarpment Plan Area, and to determine its potential for environmental land use planning.

Background: The Niagara Escarpment Plan is Canada's only environmental land use plan. As such it is the best example available of an ecosystem approach to land use planning, an approach now endorsed by the MOEE. A component of the ecosystem approach missing from the Niagara Escarpment planning process is cumulative effects monitoring. This research project, the actual testing of the first cumulative effects monitoring program in Ontario, will determine the effectiveness of the Cumulative Effects Monitoring Framework and Procedures Manual recently developed for the Niagara Escarpment Plan Area. The methodology also has the potential to be used in the municipal planning process. The need for such a program has been clearly identified by the Ontario Government and by the UNESCO through the World Biosphere Reserve designation.

Tasks:

(a) Undertake cumulative effects monitoring in accord with the Cumulative Effects Monitoring Framework and Procedures Manual and in consultation with monitoring partners (Conservation Areas, Niagara Escarpment Commission, non-government organizations, aggregate producers, Bruce Peninsula National Park, etc.).

(b) Evaluate the results to determine whether the Monitoring Framework and Procedures Manual are monitoring cumulative effects.

(e) Make adjustments, repeat test monitoring, if necessary (1996).

(f) Evaluate the results and make final changes in preparation for full monitoring on the Niagara Escarpment and other potential areas.

Applications: Results of this research will be used to assess and modify the Cumulative Effects Monitoring Framework and Procedures Manual recently developed for the Niagara Escarpment so that full scale monitoring can occur for this internationally recognized World Biosphere Reserve.

Contact: Mr. Graham Whitelaw (416-440-3734)

OBJECTIVE 2

To develop and test a watershed based data management model, for environmental resources, for use in the land use planning process.

Background:

The shortcomings associated with existing environmental data management systems have been clearly documented, most recently in Environmental Assessment Advisory Committee Report #51 *Identification, Evaluation and Protection of Environmental Resources*. Conservation Authorities play an important role in the land use planning process, operate based on watershed units and are in an excellent position to develop new approaches in the field of environmental data management. The creation and testing of an integrated ecologically-based information and evaluation system will allow for the proper identification of environmental resources, evaluation of their significance, and improve assessment capabilities.

Tasks:

(a) Examine the components of the hydrologic and ecological system to identify ecologically relevant data to be used in watershed management and the land use planning process, including a review of existing data, information gaps and agency overlaps.

(b) Develop an integrated ecologically-based information and evaluation system to meet land use planning objectives, in consultation with Conservation Authorities and other relevant agencies.

(c) Test the model on a pilot basis and use the results of the pilots to fine tune the model.

Applications:

Results of this research will be used to establish an integrated ecologically-based information and evaluation system for land use planning by conservation authorities, municipalities, government Ministries, non-governmental organizations and the public.

Contact:

Mr. Graham Whitelaw (416-440-3734)

GOAL XIII:

TO EXAMINE OPPORTUNITIES TO REDUCE *ODOUR AND NOISE POLLUTION, AND VIBRATION*

GOAL XIII

TO EXAMINE OPPORTUNITIES TO REDUCE *ODOUR AND NOISE POLLUTION, AND VIBRATION.*

OBJECTIVE 1

To eliminate or reduce the odour from asphalt cement plants.

Background:

Odours from asphalt cement plants result in a significant number of complaints to the Ministry of Environment and Energy. These occupy a proportionately large amount of MOEE staff abatement time investigating and acting upon these odour complaints.

Some of these problems are due to the type of raw material asphalt used. Therefore the identification and use of low odour potential asphalt could minimize odour impacts on the community.

Tasks:

(a) Identify odour causing chemicals in asphalt cement manufacture and their relative contribution to the total odour level produced.

(b) Identify operating parameters that impact on the quantity of the odour causing chemicals that are released.

(c) Investigate whether reduction of odour causing chemicals in the asphalt would affect the asphalt cement produced.

(d) Investigate operating procedures to determine if changes can be made economically while significantly reducing odours.

Application:

Data to be used in the establishment of operating guidelines that could be incorporated into a certificate of approval for an air emission.

Contact:

Mr. Scott Grant (416-323-5215)

OBJECTIVE 2

To study and verify the external isolation of foundation walls, of small buildings, using attached material and backfill.

Background:

Isolation of small buildings, such as single family dwellings, from ground borne vibration sources, rail or heavy equipment, has been tried in several ways in the past. A research project sponsored by MOEE in the past resulted in anomalous information on a specific isolation system, using vibration isolators **under** the footing (or foundation beams) of small building.

Recently proposal of a simpler isolation system was emerging from several consultants reports. The isolation is using a somewhat compressible material sheeting (e.g., styrofoam) **attached to the outside** of the foundation wall, with a backfill of graduated gravel and soil, to grade. While this isolation is proposed by consultants, there is no theoretical basis or experimental proof of its efficacy.

Projects using such isolation cannot be used for verification of its effectiveness, as there is no "before Isolation" information. Only a controlled experimental work of "before" and "after" measured vibration level can provide conclusive results.

Tasks:

- Select suitable small buildings exposed to vibration.
- Measure "before" vibration levels.
- Install outside isolation of foundation.
- Measure "after" isolation vibration levels.
- Repeat process with different materials.
- Analyze results.
- Provide reports of findings.

Application: Success of the outside isolation of foundation of small buildings will result in feasible vibration control of new buildings and retrofit currently unmitigated locations. Conversely, proof of the inefficiency of the proposed method will direct attention and efforts to more viable methods.

Contact: Mr. Les Kende (416-440-3588)

OBJECTIVE 3

To investigate directivity patterns for rectangular ventilation louvres installed in outside walls of enclosures/buildings housing equipment/installation sound sources, under conditions of free-field propagation outdoors.

Background: Acoustic propagation from ventilation louvres radiating sound, originated in a reverberant field, into free-field environment displays a distinct directivity pattern. Variations in sound pressure level measured at a given distance in front of a ventilation louvre may be as high as 16 dB depending on the angle of sound incidence from normal to the louvre axis. In general, -/+8 dB overall adjustment to the calculated value of sound pressure level is expected along the louvre axis and at a 90° angle respectively.

In addition, these adjustment values display wide variations at various frequency ranges of interest.

The results of literature search indicate that the available calculation procedures and test results from various sources are not consistent in defining directivity adjustments for ventilation louvres. Although there seems to be an agreement on the overall limiting range, significant differences remain in the recommended adjustments in the individual frequency bands depending on the propagation angle and sound propagation area of the ventilation louvre.

Tasks: A number of industrial sites will be selected for a sound measurement survey of directivity pattern for ventilation louvres. Due to the effect of extraneous sources typical in an industrial environment, sound intensity measurements (using sound intensity probe and an FFT analyzer) will have to be made to determine if the louvre is the predominant source. Sound level spectra will be obtained at an array of distances and propagation angles from the louvre. The results will be collated and a summary of directivity adjustments will be calculated.

Application: The results of acoustic directivity pattern investigation for ventilation louvres will serve to improve accuracy of the noise impact assessment predictions. Reliability of technical reviews in the C of A approval process will be enhanced.

Contact: Mr. Les Kende (416-440-3588)

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